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(See page 386.)

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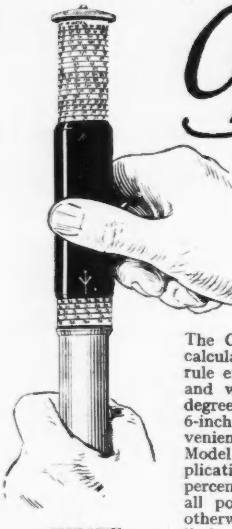

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Editorial Notes.

Thomas Edison has long been regarded by the American public as their Grand Old Man of science, and his life has just been written by Mr. Henry Ford. His little book is entitled "My Friend Mr. Edison," and it gives the story of a friendship that began over thirty years ago. The inventor was the first employer of the now famous motor manufacturer, and from their first meeting the younger man developed a strong admiration. Mr. Ford recently had the satisfaction of acquiring the laboratory where Edison developed the incandescent lamp and of adding it to his museum at Dearborn. For this purpose the building was moved more than a thousand miles, and it now stands as a permanent memorial to Edison's early discoveries. Mr. Ford explains that the work of Edison falls into two great divisions. The first has to do with his direct contribution of inventions—tools. The second has to do with his example in linking science with everyday life and demonstrating that through patient, unremitting research any practical problem may be solved. "It is probably impossible," the biographer adds, "to determine whether his actual accomplishments or the force of his example have been the more valuable to us." The scientists of the old school have never considered Edison as one of themselves because he has been more interested in practical applications than in pure research. In the same way the engineers have not regarded him as an engineer because he worked on untraditional lines. In fact, however, Edison did much to establish the modern spirit in both science and engineering, which is to say that research and its practical applications are essential the one to the other. Mr. Ford emphasizes this achievement in his most readable volume, which reveals much in common between the minds of a great inventor and a great engineer.

* * * * *

Not since 1912, when the *Titanic* went down in mid-Atlantic, has any disaster aroused such world-wide sympathy and interest as the deplorable loss of the new airship R. 101, with forty-eight lives. Whether its crashing against a hill was due to some sudden barometric change throwing the altimeters out of action, or whether the general construction was at fault, are questions for the investigating experts. Adverse opinions on the future of the airship have already appeared in certain quarters, but it would be a poor tribute on the sacrifice that has been made to regard the disaster as the final judgment on this form of flying. Any attempt to explain away its lessons must equally be avoided. One question can be discussed without delay, and that is whether helium gas ought not to be used in all future airships. It was hoped that the oil engines fitted to R. 101 would eliminate the risk of fire attaching to hydrogen, but this did not prove to be the case.

* * * * *

At present the European sources of helium are negligible for airship purposes, so that it would have to be imported. In the United States a determined search for the gas, and an equally determined effort to purify it cheaply, have been so successful that the supply is now sufficient for military balloons and airships. This gas in very impure form occurs with Natural Gas, and as much as a million cubic feet a day exudes in certain parts of America, particularly in Texas. The cost of purifying it is now about 38s. per thousand cubic feet, *i.e.*, from five to nine times the cost of a thousand cubic feet of hydrogen. It is likely that further research will reduce this ratio in

the future. The gas is found in smaller volume in Canada. Helium is the only alternative to hydrogen known to science, and although it is twice as dense as hydrogen it has more than ninety per cent of its lifting-power. It is quite safe, and it cannot burn or explode.

* * * * *

Wing-Commander Kingsford Smith's record flight to Australia in a single-engined machine is noteworthy not only as a remarkable feat of physical endurance, but as an eloquent tribute to modern aircraft design. The flight from England was completed in a little over ten days, and the record is thus beaten by over four days. The airman's previous flights had been made in a Fokker monoplane, and it is interesting to note that the record has been broken by a British machine equipped with a British engine.

* * * * *

On 10th October, the delegates to the Imperial Conference were invited by Dr. Henry S. Wellcome to meet the Fellows of the Royal Anthropological Institute, the members of the International Institute of African Languages and Cultures, and the members of the African Society, at the Wellcome Historical Medical Museum. In the course of the evening a short address was given by Lord Lugard, in which he outlined briefly the objects of these Societies, and pointed out the practical bearings of the studies with which they were concerned on the administration of the affairs of the backward peoples in our dependencies. He urged that the aim of those responsible for the government of such peoples, whether in India or in Africa, should be directed not to imposing the civilization of the white man on the non-European, but to assisting him along the path of development through his own customs and institutions, suppressing or modifying only those customs which were entirely repugnant to our sentiments and ideas, such as human sacrifice and head-hunting. In order to achieve this end with any measure of success, it was essential that native institutions should be studied sympathetically in accordance with the principles of anthropological science.

* * * * *

It is an illuminating illustration of the views expressed by Lord Lugard that the recent rising in West Africa, where the principle of governing the native through his own institutions was established by Lord Lugard, is said to have been aggravated by the imposition in one area of a native form of government in circumstances to which it was not adapted. Outwardly in conformity with the principles of government laid down by Lord Lugard, in fact it violated them. Previous study of the conditions on scientifi lines would have averted this cause of unrest.

* * * * *

The bimillenary of Virgil's birth was celebrated throughout Europe last month. In recent years the works of ancient writers have been subjected to the closest study by modern scholars, and few revelations have been more illuminating than those concerning Virgil. Readers of *Discovery* are familiar with some of these discoveries, which Professor R. S. Conway has described from time to time. On the eve of the bimillenary Professor Conway lectured to the British Academy on "Virgil's Creative Art." Discussing the poet's sense of mystery, the lecturer said that its source was to be found in his profound sympathy with the joys and sorrows of humanity, and of the whole sentient creation. The same insight had given Virgil the power to transcend and so to reconcile even the most sharply opposed schools and parties of his time in philosophy, politics and religion. "No one of these sides of human life was the same after it had been touched by the fire of Virgil's genius; and no reader of Virgil in any age was ever the same if he could realize the warmth and the splendour and the mystery of the world as interpreted by Virgil's art."

* * * * *

An important development in railway travel is foreshadowed in Germany by the invention of a saloon coach, driven by an aeroplane engine, which is capable of a speed of 93 miles an hour. The coach was tested last month on an experimental track between Hanover and Hamburg, and is constructed of steel tubing, covered with sheet aluminium and balloon fabric. An attractive new feature is a secret method of springing, which is so effective that the passengers in the experimental trip were unaware of any vibration or swaying movement. In next month's issue of *Discovery*, we shall describe a new British "railplane" invention which has recently been tested with satisfactory results. Under favourable conditions, it is anticipated that a speed of 120 miles an hour will be possible.

* * * * *

A British expedition is to start early in 1931 to the Western Himalaya, where an attempt will be made to ascend Mount Kamet. The mountain is over 25,000 feet in height, and is the second highest peak in the British Empire. Several well-known mountaineers have already tried to climb to the top of Mount Kamet, so far without success, and considerable interest attaches to this new attempt. The most successful effort was that of Dr. Kellas who climbed within 2,000 feet of the summit.

Birds of the North Atlantic.

By V. C. Wynne-Edwards.

Of the hundreds of bird-lovers who cross the Atlantic every year, how many attempt a systematic observation of the birds they see? With the aid of a map showing the route of a recent trip to Quebec, an expert here outlines the distribution of various species, and stresses the value of more widespread observation.

LAST September, when crossing from Southampton to Quebec in the *Empress of Scotland*, I made a log of the birds seen on the voyage. Many people must sometimes have felt inclined to make observations of this kind, and it might add to the interest of their occupation if they knew something about the birds they were likely to see, and realized how valuable their observations might become. The number of species is not great. They constitute a class of gipsies among birds wandering up and down the world, and most of them are new to the landsman. Their movements are not altogether haphazard, however, and I have tried to make a picture of their distribution at this season, a distribution that is always changing and yet always being repeated as each year goes by.

The map on page 361 shows the track of the liner on Mercator's projection. It shows days and nights and times when a watch was kept. It illustrates also the edge of the continental shelf, which divides the permanent ocean from the narrow seas. This division is one of the most marked in marine ecology, and affects not only the animals of the sea bottom and the fishes, but also the plankton, that teeming layer of minute animal and plant life which drifts along within a few fathoms of the surface, and has been well called the pasture of the sea. The reason for this is probably to be found in the circulation, the physics and chemistry of the water, which change comparatively rapidly from the ocean towards the land; the same cause, whatever it is, also affects the birds.

The Sea-gull not Oceanic.

It is a surprise to most people to discover that sea-gulls are not oceanic birds. The black-headed gull, for instance, is closely tied to the shore. The herring gull and the two black-backed gulls make longer journeys out to sea and often follow boats across the Channel or the Irish Sea. The kittiwake is the most marine of the British gulls; it seldom comes ashore except for breeding, but at the same time it does not go far out to sea. Sailing out from harbour, kittiwakes are met as soon as land is cleared; they collect from all sides on the fishing grounds when a trawler hauls her gear, attracted, I have often thought, by the white column of steam from the funnel when the winches are working. Over deeper water, as between the Lizard and Ushant, they become scarcer and on the high seas they are merely vagrants. Actually, the last gulls seen on the way out from Cherbourg were lesser black-backs, which were observed some way west of the Scillies (8° 30′ W.). About a hundred miles west of this that other common bird of the English coastal waters, the gannet, reached its limit, and almost at once the true oceanic birds of the family *Procellariidae* were seen.

Distribution of Sea Birds.

A clearer idea of the distribution of sea birds is obtained by picturing zones running parallel to the coast. The first zone would be a narrow one, skirting close along the shore, including creeks and bays and estuaries, where the black-headed, common and herring gulls feed, and the shags and cormorants. The next zone would include all the narrow seas up to the edge of the continental shelf. Here there is a great variety of species, for example, kittiwakes, gannets and the auk family—razorbills, guillemots and puffins. A few members of the *Procellariidae* are found in this zone, such as the Manx shearwater and Mother Carey's chickens or stormy petrels. The birds of this second offshore zone differ from those of the first in that they do not come ashore except to breed, while those of the inshore zone often land and sometimes sleep ashore. The third zone is the ocean beyond the continental shelf. Here the birds are cosmopolitan for the most part, and are confirmed wanderers; they have a highway round the world and are as much at home in the Pacific as in the Atlantic. It is these birds which the landsman only sees if he visits their breeding places, and which follow in the wake of ships a thousand miles from land. Last September there were three abundant species of *Procellariidae*, the fulmar, the great shearwater and Wilson's petrel.

The first fulmars were observed about 10° 40′ W., while there were still a few gannets to be seen. A

stuffed fulmar in a glass case looks rather similar to a common gull at first sight, but the living bird, alternately flapping with strong steady beat and gliding on broad curved wings, is very different from any gull. It is white except on the upper side of the wings and back, which are a pale and slightly brownish grey. It is more sturdy and has a thicker neck than a gull. The young are speckled brown, with a pale, almost golden patch on the outer flight feathers and a white tip to the tail. When gliding into the wind, the bird opens its flight feathers like fingers and closes them as it banks over at a high angle and makes off to leeward. It has recently been put forward by Lieut. R. R. Graham, R.N., that this separation of the primaries, seen in many birds, is Nature's version of an ingenious safety device known as the Handley-Page wing slot, which prevents aeroplanes from stalling, as paper darts do, when flying too slowly to obtain sufficient lift without it. It is worth noticing that the fulmar spreads its feet on either side of the tail to assist in steering, just as razorbills and puffins spread theirs.

Abundance of Fulmars.

Like most of the northern sea birds, fulmars breed on both sides of the Atlantic. On the way across they were fairly abundant, except just in the middle, till we reached the boundary of zone two on the other side, off the coast of Labrador. The great shearwater (*Puffinus gravis*) on the other hand, was not seen until we were at 21° 30′ W., and was decidedly more common on the western side. This bird is about the same size as the fulmar and roughly the same shape. Its wings are fairly dark brown above and there is a conspicuous white patch at the base of the short sooty black tail. The best character, however, is the deep brown cap on the otherwise white head and neck. The bird is a dirty white underneath and has an inconspicuous brown mark on the belly. It does not fly as high as the fulmar, but glides within a few inches of the waves in true shearwater style. Like other petrels, it is a surface feeder and was notably most common in the vicinity of whales and porpoises. One calm dawn (40° 30′ W.) I saw a very large school of porpoises, at a distance of about a thousand yards, churning the glassy flatness of the water like breakers on a reef, and round them were scores of great shearwaters and fulmars. Wherever there were whales spouting there were sure to be great shearwaters about; it seems likely that they feed partly on the leavings and faeces of whales.

Altogether different from these two birds is Wilson's petrel, commonly known as Mother Carey's chickens, although this name is applied correctly only to the stormy petrel. It is a small blackish bird with a white rump, about the size of our nightjar and with the same buoyant and erratic flight. To anyone familiar with the nightjar the resemblance of flight and form is very striking. Wilson's petrel is considerably larger than the stormy species, and reminds one of an outsize house-martin. It is distinguished from Leach's petrel, which breeds in the British Isles, by being sooty brown and not slaty-grey above, and by having a paler brown patch on the upper wing coverts. Both species have forked tails, although statements to the contrary are sometimes made, but the emargination of the tail of Wilson's petrel is very slight, particularly when it spreads the feathers. In a wind, these birds fly faster and twist and turn from side to side and up and down in a most uncontrolled manner.

Both this and the great shearwater are particularly interesting because they breed in the southern hemisphere and winter in the northern. We are familiar with the migrations of our own summer residents, a good many of which spend the winter in the far south, but it seldom occurs to us to ask why we have no southern species "wintering" here during our summer: these are two of the only cases. The great shearwater breeds on the Trista da Cunha group and perhaps elsewhere; Wilson's petrel breeds in Kerguelen, South Georgia, and on the Antarctic continent; both wander to the ends of the earth at other times of the year, some spending the months of the Antarctic winter in the north Atlantic.

American Zones.

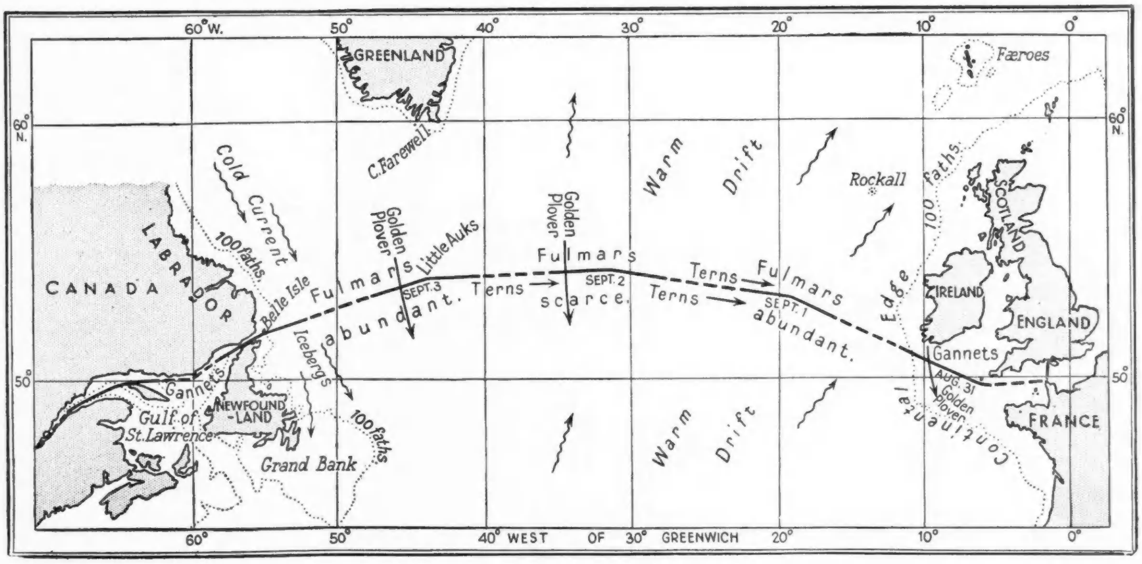
On the American side the same zones are apparent. The continental edge, as can be seen from the map, is quite close to the land off Labrador and north Newfoundland, so that oceanic conditions obtain right up to the mouth of Belle Isle Strait. Three fulmars were seen actually within a mile of Belle Isle, though they had ceased to be plentiful about fifty miles before we reached land. Wilson's petrels disappeared about forty miles east. The great and sooty shearwaters came some way into the Gulf of St. Lawrence, but only in small numbers. A greater black-backed gull and a party of kittiwakes appeared twelve miles east of Belle Isle, and four herring gulls flew by as we steamed along the north Newfoundland coast. Then as we got clear of the Strait and out into the Gulf of St. Lawrence, we were back again in zone two, with the same birds as are seen in the English Channel—puffins, gannets, kittiwakes, and occasional great shearwaters.

Off the north coast of Anticosti there were at one time forty-three gannets in sight on one side of the ship, but shortly afterwards they completely disappeared. From that point to Quebec we crossed three hundred miles of the most birdless water I have ever seen ; apart from a single white-winged scoter and a very occasional gull, there was never a bird to be seen. The water had changed from blue-green to a deep olive colour, probably brought about by an exceedingly fine suspension of sediment and by the admixture of fresh water from the St. Lawrence River. It was to some extent an enormous replica of the almost equally birdless Bristol Channel, where the mud and fresh water kill the plankton, and consequently impoverish all marine life to such an extent that it will not support any sea birds except the scavenging gulls which follow the shipping.

Before leaving this subject there are two points which may be emphasized. The first is the fact that almost all the sea birds on both sides of the Atlantic are the same. There is nothing very striking in this, in fact, it is the exceptions—the black-headed, common and lesser black-backed gulls, and the shag and cormorant of the European side—that are more notable, illustrating how coast-limited are the wanderings of these species. The other point concerns the ecological zones which I have outlined. These zones are not always sharply separated from one another, although they are so as a rule. In the same way, though not without many exceptions—two little auks, for instance, were seen four hundred miles off Labrador—it appears that the three principal families of sea birds, namely, the *Laridae* (gulls), *Alcidae* (auks) and *Procellariidae* (petrels and shearwaters), are each typical of one of the three zones. So that instead of the names inshore, offshore and oceanic, we might say gull zone, auk zone and petrel zone.

So far no mention has been made of the skuas, of which two species were seen. Skuas are predatory wanderers, swooping down wherever a group of gulls or terns has found something to eat. They are a branch of the gull family themselves but are dark brown in colour instead of white. They are wonderfully agile and swift on the wing and obtain much of their food by chasing gulls and frightening them, so that they disgorge all their food. The skua sweeps down and often catches the food before it reaches the water. At other times, however, skuas fish and scavenge for themselves.

The two species seen were the Arctic and great skuas. The Arctic species is a graceful gull-shaped bird, deep brown above and cream-buff on the breast. The yellow covers the lower part of the head and meets on the top of the neck, giving the bird a brown cap not unlike that of the great shearwater. The two middle tail feathers are elongated and pointed, which is the best distinction of this species from the closely similar pomatorhine skua. Arctic skuas were numerous all the way across from about 10° W., and a few were seen in the Gulf of St. Lawrence ; great



DISTRIBUTION OF NORTH ATLANTIC BIRDS.

This map, which was compiled by the author on a voyage from Southampton to Quebec, shows the times when a watch of the birds of the North Atlantic was kept.

skuas were much less abundant. These are much larger and heavier birds, more hawk-like, and with a prominent white patch on the wing at the base of the primaries. Both species are very powerful fliers, and independent of any zone. I have sometimes seen great skuas in the English Channel and the Irish Sea at this time of year within a dozen miles of land.

Migration of Terns.

There is still the most interesting side of the observations to relate. About 20° W. we met five terns going east; five hours later there was a party of fifteen, with four Arctic skuas attending them, travelling in the same direction. On the following day, 2nd September, in the course of three and a half hours' watching, I saw a hundred and five terns, still going east. Next day, there were not so many, but small bands were seen frequently until 5 p.m., in long. 46° 30′ W. With two exceptions, every single one of these birds was on a course lying between E.N.E. and E.S.E. It is to be borne in mind that a ship steaming west at twenty miles per hour would naturally pass more birds going the opposite way than in any other direction. Even so, there is no doubt that we were observing a definite and prolonged movement of terns from west to east. There is confirmatory evidence. When terns are fishing, they do sometimes sit on the water to eat what they have caught, but they do not do so nearly so freely as gulls. None of these terns seen on the Atlantic ever stopped to fish, and only three were resting—not on the water but on driftwood and floating boxes, hundreds of miles apart. They were fasting, like most migrating birds. It is difficult to distinguish the species on the wing, but I believe all these were Arctic terns.

All the birds observed so far have been web-footed and are therefore at home on the sea; the terns, perhaps, less so than the others. On four out of the five days of open sea, however, real land birds were seen, utterly unable to alight on the water and without food. As we passed about a hundred miles south of the Irish coast, I saw a sand-martin and another unidentified passerine bird on their southward migration. The other land birds, except one, were all waders; I think the exception was the golden plover. One was at 9° 30′ W., flying south from Ireland; the second, two days later, was in mid-ocean, six hundred miles south-east of Greenland, 34° 30′ W.; the third was about five hundred miles due south of Cape Farewell, Greenland, 42° W. It is difficult to be sure of the identification, because the birds are seen and lost in a few moments, but all were either golden or grey plovers (*Charadrius sp.*). These birds are famous for their stupendous migrations. Excepting the first one, it is unlikely that they reached land before the Azores, more than a thousand miles further south; possibly they never reached it at all. At present, no one has the slightest idea of how these birds manage to shape a course and keep it on their journeys across the sea. The other wader was probably a Hudsonian curlew, not distinguishable in flight from our whimbrel. It remained for some minutes round the ship, about ten miles off the Labrador coast.

There are probably quite a number of accounts of these birds seen on migration so far out to sea, although I have not come across them. There is a great deal of investigation of this kind still to be done, and it would pay those interested in birds who cross the Atlantic to keep a sharp look out. There is also practically nothing known about the seasonal distribution of marine birds. If voyagers all pooled their observations, we should be able to make maps showing how, for example, the fulmars radiate out from their breeding places on either side, and gradually bridge the ocean; how the great shearwaters and Wilson's petrels work up from the south, and return there again. On this voyage there were scarcely any fulmars, only eight being seen throughout the day, between 28° and 36° W., that is, in mid-ocean. But there were hundreds of them, even thousands in the course of the day, nearer each side. One is led to suppose that by the first week of September the business of dispersal from their breeding places is not complete.

Science at London University.

In recent years science courses do not appear to have been in very great demand in university extension work in London, but the current programme issued by the University of London shows that lectures on scientific subjects are coming again into popular favour.

Foremost among the courses arranged is a series of twenty-four lectures on Modern Ideas and Work in Zoology. The time of the lectures—six o'clock—should prove helpful to those city workers who are interested in this subject, and desire to hear of the most recent advances and the outlook for the future. Courses in Evolution, Heredity and Biology will be given in such widely separated parts of London as New Cross, Stratford and Woolwich; and an introductory course in Psychology will also be conducted. Details regarding these and other courses may be obtained from the University.

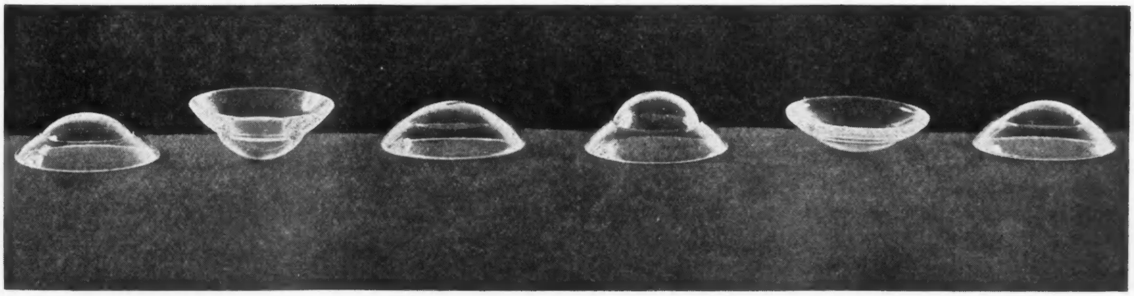
No More Spectacles ?

New experiments with " contact " eye-glasses, which dispense with frames and are held in place by adhesion to the eyeball, have recently aroused considerable interest. The glasses, illustrated below, are thin shells made of optical glass which can be worn under the eyelids and in contact with the eyeball. In 1888, Dr. A. E. Fick, of Zurich, an eye specialist, invented contact glasses mainly for the correction of a condition of thickening and arching of the cornea ; the so-called " Keratoconus," which reduces the power of sight. It was soon seen that the keratoconus was not only corrected by reason of the fact that the contact glasses acted as an orthopaedic support on the cornea, but in addition there was actual healing. The contact glasses lie over the cornea and the pupil, and the border rests on the sclera. The cornea part is a carefully cut bowl, and its purpose is to correct eyesight errors ; the border should adhere to the eyeball with only a thin layer of tear excretion between.

It was thought that the contact glasses might be used for the benefit of far or short-sightedness, and numerous experiments were made. The real advantage was discovered to be in the fact that as the contact glass rests on the eyeball, it follows all the movements made with the eye, and therefore remains in focus. The great disadvantage of spectacles is the fixity of their optical axis with which the axis of the eye does not always register. With the contact glasses, which follow the movements of the eyes, the axes naturally always fall together and the picture is sharp in all directions. There is no restriction of view-field such as the size and form of spectacles bring about. For ladies and actors, for instance, a further advantage is claimed in that the wearing of contact glasses is not distinguishable, and for the short-sighted there is strong magnification of the picture on the retina. It is not expected that contact glasses may be worn, like spectacles, for indefinite periods, for after a while the pressure of the adhering glass on the sensitive surface of the eye may cause pain and discomfort.

Earlier this year Professor Heine, of Kiel, made experiments with various contact glass forms and reported corrections of eyesight failures by their use. He found that, after getting accustomed to the glasses, they could be worn in many cases to replace spectacles. In the treatment of keratoconus he noticed an improvement in short-sighted persons, and his experience, following that of Dr. Fick, will undoubtedly be carefully tested at various eye-clinics. The photograph reproduced shows several forms of contact glasses which have recently been prepared for the use of eye-specialists. After testing, the most satisfactory will be chosen for use. It is the bowl form which covers the cornea that corrects errors of sight, and particular attention will be paid to this in testing. The border lying on the choroid will also be tested in order to find the best curvation and to ensure that the glasses sit comfortably. Contact glasses up to six dioptrics come chiefly into question for correction of vision, since above this they would be too thick and too heavy. To begin with, a patient will wear them only for an hour at a time, and they will be placed into position and removed by the specialist until such a time as the patient becomes fully accustomed to the handling of the glasses.

In time, perhaps, the use of contact glasses will pass out of the sphere of experiment, and will take the place of spectacles, so giving the defective-sighted a better definition in colour and in perspective, as well as less unsightly eyewear.



THE NEW "CONTACT" GLASSES.

Several forms of the new " contact " glasses prepared for use by eye specialists. In forthcoming tests, the most satisfactory type of glass will be selected for practical use.

The Men of the Trees.

By R. St. Barbe Baker.

Increasing deforestation raises a world-wide problem of economic as well as industrial significance. A society of tree-lovers, founded among African natives, has already done much for the preservation and planting of trees in many parts of the world, and is about to launch an extensive campaign in Wales.

To create a "tree-sense" and to encourage everyone to plant trees everywhere is the ideal set forth by a new society of tree-lovers with world aspirations. The world needs trees to-day as never before and each year, as scientific knowledge advances, many new uses are found for forest products; before the war the articles generally made from wood were numbered at five hundred; to-day, with the development of the cellulose industry, something in the neighbourhood of four thousand uses for wood or wood products can be counted.

Trees, apart from their direct economic value, exert a beneficial influence affecting climate, agriculture and the very existence of man. This can be more clearly demonstrated in Africa, where vast areas are drying up and becoming de-populated as the direct result of forest destruction. Recent scientific research has shown that the Sahara has not always been desert, and remains of trees have been found on the banks of vanished rivers and on the shores of dried-up lakes. A further interesting fragment of evidence goes to show that an early king of Egypt received a present of five hundred buffaloes from a place which is now near the centre of the Sahara. As all African sportsmen know, the buffalo prefers to inhabit districts in and around forest regions, grazing in the open parklands or on the fringe of a forest in the early morning or late evening, and lying up in the forest during the daytime. It would appear that at one time about a million Arabs settled in parts of Africa which are now desert. They cleared the forests to make their farms, moving on to repeat the same process of destruction as soon as they had reaped their crops. They brought with them vast herds of goats; it would be conceivable to estimate that each Arab possessed something in the neighbourhood of one hundred goats. A hundred million goats, following in the train of nomadic farmers, would not allow much tree growth; the goat, as is well known, is the *bête noir* of the forest.

To the north of the Gold Coast, in territory which comes under the French sphere of influence, it has been pointed out that racial suicide is being brought about as the result of forest destruction. In certain tribes, chiefs have forbidden marriage, while women refuse to bear children because they see the end of the forest in sight and they will not raise sons and daughters to starvation. They have been trapped in a wedge of the forest with desert right and left of them, and desiccation is travelling fast in their wake. In many instances, the shifting sand is burying their poor crops and driving them into the remaining wedge for their present cultivation. This is an extreme case, and graphically shows what may be the result of neglecting to form forest barriers when old primitive methods of shifting agriculture are in vogue. In the

A FOREST NURSERY.
The Men of the Trees are pledged to do one good deed every day. Eighty thousand young trees were raised in this forest nursery by African natives as their "good deed."

wake of a destroyed forest large sandy wastes rapidly spread and are resulting to-day in the drying up of vast areas of this great continent.

When I first went into the Highlands of Kenya I came across a tribe of forest destroyers, and when I talked to them about tree planting everybody agreed that it would be a very good thing, but the problem was to persuade them to plant trees without payment or compulsion. I had given long talks in many meetings of chiefs, but apparently the seed had not taken root and no action had at first resulted. One day an inspiration came to me. I had been watching ceremonial dances and had learnt that, in these parts of Africa, there was a different dance for every season of the year. There was a special dance, for instance, when the beans were planted and another when the corn was reaped, and before setting out on a lion hunt the tribesmen stimulated their courage by a special dance. Even when there was apparently no particular object, they would frequently dance. Suddenly the idea came to me of suggesting a ceremonial tree-planting dance ! Everywhere young African warriors were pouring a vast amount of life and energy into their warlike skirmishes, forest burnings and dancing. I was convinced that such an impulsive body of stalwart fighters could be influenced for good instead of being left to continue in old habits of destructiveness through sheer ignorance of better uses for their energy. I had thought of applying the principles of the Boy Scout movement but, when on a visit to Nairobi, I ventured to discuss the matter with brother officers, the idea of putting "natives" upon their honour was condemned as wildly impracticable. I was considered a visionary and, but for the encouragement of an American official, an Italian padre, and a British settler, I might not have persisted.

FOR MARGARINE.
A Sobo native collecting palm produce which will eventually be used for making margarine. This is a minor product of the forest.

As it was the height of the dancing season, it occurred to me that here might be an opportunity for introducing a tree-planting dance and, in so doing, to reach the young blood of the tribe, for all the young men were passionately fond of dancing. First of all, I sent for the captains of the various N'gomas, or dances, and gave them an invitation to bring their followers and join in a competitive dance which I was about to arrange. This new dance, I explained, was to be the Dance of the Trees, and I promised a prize of a fatted ox for the best turned-out Moran. As their women could not possibly be left out on this auspicious occasion, a necklace of their favourite beads was promised to the most beautiful damsel. The winning Moran was to be chosen by myself, assisted by a committee of chiefs, and the damsel was to be elected by the popular vote of a committee of Morans, presided over by my prize-winner. The captains of the dances excitedly expressed their pleasure at this new idea, and hastened to their various towns and villages to spread the news.

At length the day of the great dance arrived. It was one of those perfectly fine days of glorious sun and crisp air to which one becomes almost accustomed in the delectable highlands of Kenya. As I dressed, I felt that at least the elements were with me, for the sun was already rising over the distant mountains, and when the early mists cleared the snow-capped peak of Kenya caught the morning sunlight, while her sister Kilimanjaro, a hundred miles away, resembled a giant's breakfast table spread with a snowy white cloth which overhung its square top. It was hard to imagine that one was on the equator, for in spite of the sun, as I sat down to breakfast I was thankful for a roaring fire. Early as it was the excitement had begun, for soon runners arrived to say that their tribesmen were approaching in thousands. Three hours later these eager young warriors were massing in a great column between two hills, about a mile from my camp, where they were sorting themselves out and putting the finishing touches to their elaborate make-up in readiness for a grand march-past. At

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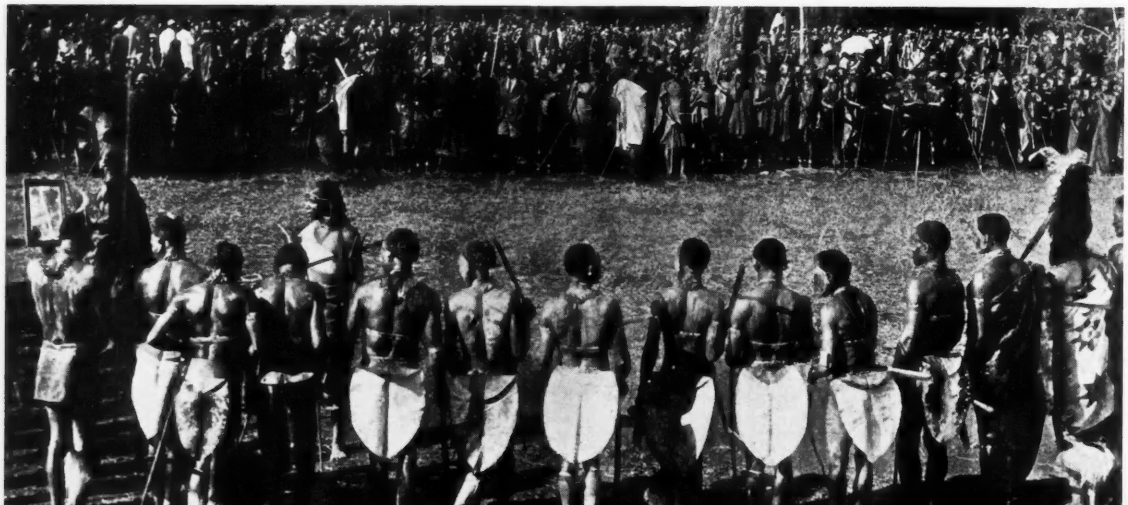
a given signal the great throng started to advance, rank upon rank, carrying their spears and shields. On they came in a constant stream, prepared as if for battle, yet on the spear points was the ball of ostrich feathers to signify that they came in peace. With proud dignity they marched past the raised platform which had been erected for the occasion and then, halted by their captains, they formed orderly ranks to listen to the address of welcome awaiting them.

That day, the Dance of the Trees was inaugurated, and in response to my appeal, and with the assistance of the chiefs, I picked out fifty for the trail experiment from five hundred volunteers; many were sons of chiefs and head men, and all of them came of yeoman stock. These fifty promised before N'gai the High God to plant trees and protect them everywhere. A badge of office was there and then tied upon their left wrist to remind them of their vow—a small brass disc bearing the words "Watu wax Miti." The badge was fastened with a kinyatta, a narrow leather band, worked with green and white beads. Later, the well-known rule of the boy scouts, "One good deed each day," was added to this simple ceremony. After the first fifty, no more volunteers were called for; every new member had to be proposed by one of the chiefs, all of whom had already been initiated and given the rank of "Forest Guide," the equivalent of our scout masters. At first, this rank was only given to chiefs, although it is now open to any member who has introduced a hundred recruits who have proved their worth.

It was important to safeguard the organization and to enlist only those who had the ability to perform their promises, and nowadays it is generally the case that tree-planting volunteers are all yeomen with a recognized status in the country. Gradually, there came into being a simple initiation ceremony which is intended to express the spirit which characterizes the movement. This ceremony had a tremendous effect upon the simple and impetuous heart of the African warrior, as was shown when, some days after the first big initiation ceremony, a number of the new initiates came to my camp. One stalwart spoke up for the rest: "Bwana, we have come to ask you to help us to think of a good deed. In two hours the sun will go down and so far we have been unable to think of a good deed to do. Please help us." I was astonished; they wanted to do something very definite then and there to fulfil their obligation, so I suggested that there were thousands of young seedlings waiting to be planted out, and every man who planted his fifty might count this as his good deed for the day. To this suggestion they willingly consented. Evening by evening they came to my camp and, when they could not think of a better deed to do, they planted out young trees, raising eighty thousand in the first nursery at Kikuyu. With the encouragement of interested chiefs, this good work has continued and has resulted in lasting benefit to their country. The story of how these forest destroyers became tree planters has spread



PREPARING FOR THE "DANCE OF THE TREES."
The inauguration of the society of tree-lovers in the Highlands of Kenya was marked by a tribal dance in which hundreds of natives took part.

to other countries and has fired the imagination of youth for a practical ideal.

At the invitation of Sir John Chancellor, I went to Palestine to assist in setting on foot the Men of the Trees in that country. A meeting was held in Jerusalem, when representatives of all sections of the community and the public in general were invited, and officers were appointed. I was privileged to take part in a tree-planting ceremony in which four thousand school children planted young trees along the main roads of the rising suburb of Bayit-Vegan; about sixteen thousand of the inhabitants of Jerusalem marched out to witness the ceremony. I found that the "tree sense" already existed to a marked degree among the Jewish section of the community. Considerable local interest in tree-planting was aroused, and in July of last year a letter jointly signed by Lord Allenby, Lord Melchett and Sir Francis Younghusband, chairman of the Men of the Trees, appeared in the Press, drawing attention to the need of afforestation in Palestine and of voluntary effort to benefit this land of historic interest and future prospect. As a result of these and other steps taken, a sum amounting in all to over seven hundred pounds has been collected. Nearly sixteen thousand trees have already been planted in the Judean hills on the road from Jerusalem to Jaffa, the chief species being the Jerusalem, Italian and Austrian pines, the hackberry, Palestine oak and juniper. The work is still in progress, and the coming season is full of promise.

A YOUNG PLANTATION.

Young teak trees planted by African natives who recognize the danger of widespread forest destruction. The plantation is only six years old and is now ready for thinning.

I also visited Canada and the United States of America to further the ideal of the Men of the Trees in those countries. Among one of my most appreciative audiences were military cadets of the Citizen's Army Training Camp, where I spoke to over twelve hundred at the request of the commanding officer. A conversation with President Hoover showed his keen interest in the conservation of the forest resources of the United States, and particularly in the work of the Men of the Trees. That same night in Washington, I met a hundred and fifty foresters from all over the Eastern States and conferred with them for over four hours. I found them fully alive to the seriousness of the forestry situation in their country, where they have cut over seven-eighths of their virgin forests and are using four and a half times as much as they produce every year. Canada and the United States, with one-twelfth of the world's population, use half its forest products.

This year, the Men of the Trees in Britain are making a special endeavour with a view to assisting employment in the distressed mining areas. The Welsh hills are the natural domain of forests, and the coal beneath the surface is evidence that vast forests have been buried. Even at high altitudes, there is evidence that, when once established, certain trees of economic value will thrive. Added to this, the floods of last year have emphasized the importance of re-afforestation. Tree planting is a task to which willing workers may be quickly trained, and the fencing of the areas to be planted can be carried out immediately. Scattered areas of land in the distressed districts are available for planting; one of these sites is at Brynmawr.

We have our training site in view which may be acquired by the Men of the Trees, and under proper supervision those who are unable to obtain employment elsewhere may be encouraged and instructed in their new work. The Men of the Trees have undertaken to raise a fund for this valuable work of reconstruction in Wales which, while affording immediate employment, will bring lasting benefit to the community. At the back of the idea of planting a tree is the spirit of constructive service; the beauty of the countryside which we enjoy to-day is a heritage from the past, and we may well ask what we are doing to pass on this legacy to successive generations.

Measuring the Temperature of Stars.*

Recent research in America has enabled astronomers to measure the temperature of stars which are over six hundred times fainter than those barely visible to the naked eye. An attempt will shortly be made to discover the nature of the rocks which compose the surface of the moon.

MANY of the instruments used in conducting present-day scientific research are of extraordinary sensitiveness and precision. This is particularly true of a device called the thermocouple, an improved type of which Dr. Edison Pettit and Dr. S. B. Nicholson, of the Mount Wilson Observatory, have recently developed and which they are using in measuring the heat of stars and planets. Employed as it is with the hundred-inch telescope, it is so sensitive that the heat of a candle one hundred miles away could be detected with it were there no loss of heat due to absorption by the atmosphere.

An Impressive Feat.

With this instrument these investigators have accomplished the astonishing feat of measuring the heat radiation of a star of the thirteenth magnitude. This achievement is impressive when it is recalled that stars just visible to the unaided eye are of the sixth magnitude, and that the faintest stars photographed with the hundred-inch telescope at Mount Wilson, the most powerful telescope yet constructed, are of magnitude twenty-one. A star of the thirteenth magnitude, therefore, is about 631 times fainter than the faintest star which most of us can see, and yet this instrument is responsive to the heat which can be focussed on it from such a star. This exploit becomes even more impressive when it is realized that a star of the sixth magnitude, that is, one which can barely be seen, radiates upon the whole United States no more heat than the sun radiates upon one square yard of surface. Yet, in the case of such a star, the thermocouple will show that the increase in heat on account of it is one-half of one-millionth of a degree Fahrenheit, and that the electric current generated thereby is about one twenty-billionth of an ampere. This value becomes intelligible in consideration of the fact that the light in an ordinary incandescent house lamp is produced by a current flowing through it of from one-fourth to one ampere.

The heat of a star of the thirteenth magnitude produces a proportionately feebler current, yet a current that is not too feeble to be detected and measured. The extreme sensitiveness of the thermocouple is again illustrated in the case of stars as they rise above the horizon. The higher they ascend the brighter they appear to grow, because the higher they rise the less of the Earth's atmosphere their rays are obliged to penetrate and consequently the less their rays are absorbed. The sensitivity of the thermocouple is so great that with bright stars near the horizon the change in brightness which takes place in one minute of time can be detected.

The principle upon which the thermocouple is based can be grasped from the diagram opposite. Two strips or wires of different metals, iron and copper for instance, are welded together at their ends, Z, T. One of them, the copper strip in the diagram, is cut and an instrument, G, a galvanometer, very sensitive to electric currents, is inserted. A complete electric circuit, of which the galvanometer is a part, is thus formed. When one of the junctions, T, is heated to a higher temperature than the other Z, an electric current is set up, the strength of which, as recorded by the galvanometer, varies as the difference in temperature varies between the two junctures. For example, if a lighted match be held at T while Z is kept cool, the galvanometer quickly registers a current. If ice be applied to T and it becomes colder than Z, the current flows in the opposite direction. It was upon this principle that the original vacuum thermocouple was first developed. Pettit and Nicholson have improved the instrument with marked success.

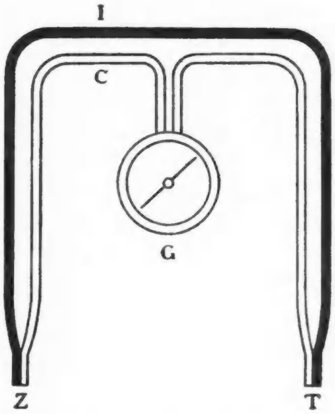
Construction of the Thermocouple.

The essential part of the thermocouple consists of two exceedingly minute wires fused together at the ends. One of these is of bismuth, the other is of an alloy of bismuth containing five per cent of tin. These are connected electrically to a galvanometer in such a manner that the currents produced when the junctions are heated separately flow in opposite directions. Small thin metal plates are fused over the junctions of the thermocouple wires and covered with a mixture of lamp-black and platinum-black on their exposed surfaces. These black plates absorb all the radiation

* This article is based on a report received last month from the Carnegie Institution, Washington.

from celestial objects within about two per cent and convert it into heat. To reduce the loss of the star's heat from conduction, the thermocouple is operated within a vacuum. The weight of a complete thermocouple, including the metal receiver and connecting wires, is about one-tenth of a milligram or about one one-thousandth the weight of a drop of water. The mass of the receivers themselves, the parts of the apparatus upon which the heat rays of the stars are focussed, is only about a third that of the complete thermocouple.

In practice the instrument is mounted upon the hundred-inch telescope, which is trained upon the star to be examined. The rays of the star fall upon the concave mirror of the telescope, whereupon they are focussed upon one of the junctures of the thermocouple corresponding either to T or Z in the diagram. Currents produced in this way are proportionate to the amount of heat received by the thermocouple, so that the deflection of the galvanometer, when a star is focussed on the thermocouple, is a measure of the heat received from the star. The deflections of the galvanometer thus induced are recorded photographically. Under favourable conditions they can be measured with extreme accuracy. Thousands of observations have been made with the thermocouple and have lead to conclusions of the greatest importance regarding the condition of stars and planets.



PRINCIPLE OF THE THERMOCOUPLE.

When a star is focussed on the instrument, a deflection of the galvanometer 'G' records the heat. The diagram is described in the text.

With this instrument it has been found that stellar temperatures range from 23,000° C. absolute (41,000° F.) for the very blue stars like Zeta Orionis, to 6,000° C. absolute (10,000° F.) for those like the sun, and 1,800° C. absolute (2,800° F.) for the very red long-period variable stars like Omicron Ceti. The hottest stars do not necessarily give us the most heat. They radiate the most heat per unit of area, but a cooler star may be so much larger that its total radiation exceeds that of the hotter star. This is illustrated by an electric light and an electric stove. The filament of the light is much hotter than the wire coil of the stove, but the latter is so much bigger that the total energy radiated from the stove is much greater than that from the light. On the other hand, the electric lamp gives more light than the stove.

There are stars like the electric light—small, very hot and bright, with comparatively little heat outside the visual region ; and there are stars like the stove—big, comparatively cool, and faint visually but with an enormous amount of heat radiation, which can be measured with the thermocouple. The coolest stars observed are the long-period variables. Because they are so cool they are very red and give very little visual light in proportion to their heat. The coolest of these which has been measured is Chi Cygni. At minimum brightness its heat is equal to that of a hot star fifty thousand times as bright. It is possible that there are still cooler stars which give little or no light, the heat of which could be measured with the thermocouple if the astronomers knew where to find them.

If the temperature of a star is known and the total amount of energy radiated from it can be obtained, its diameter may be calculated. If the distance to the star is known, the total radiation from it can be obtained from that falling on the mirror of the telescope, which is the amount measured. Without knowing the distance to the star, however, its angular diameter can be obtained. The angular diameters of some of the largest stars have been measured directly with the stellar interferometer. The values obtained from heat measures, while in most cases somewhat larger than those obtained with the interferometer, are of the same order of size. They tell us, for example, that the star Sirius, although much hotter and closer to us, is so small that the total heat from it is about equal to that from the big star Betelgeuse, which is over thirty times as far away. The diameter of Sirius is one and a half times the diameter of the sun, while the diameter of Betelgeuse is more than two hundred times that of the sun.

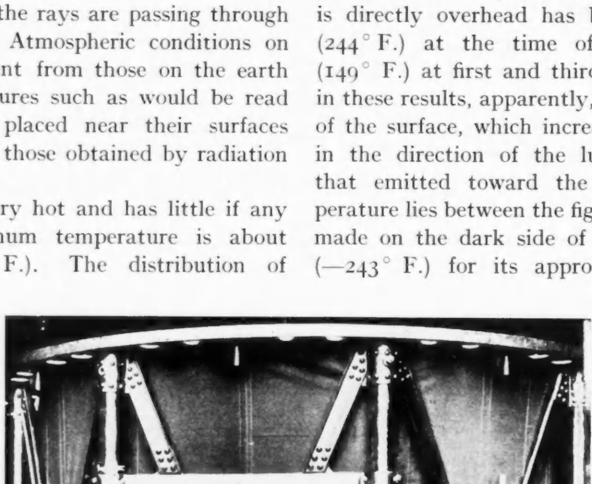
The vacuum thermocouple, attached to the hundred-inch telescope, has also been used to measure the temperatures of the planets and, still more recently, the temperatures of various regions of the moon. Our knowledge of such temperatures, as well as of the temperatures of the stars, comes from a study of the amount and quality of the radiation which reaches us from them. The moon and the other planets, of course, are much cooler than the stars ;

consequently the light that we see when we look at them is reflected sunlight. But they also radiate energy-waves of lengths too long to be visible to the human eye. This part of the radiation is called planetary heat. Planetary heat cannot pass through glass, for the wave-lengths are too long, whereas reflected sunlight can. It is therefore easy to separate the one from the other by placing a thin glass screen in the path of the radiation. In practice, the planet to be studied is first observed without any glass in the optical path of the telescope. The thermocouple is then heated by all the heat from the planet, planetary heat and reflected-sun heat, most of the latter being visual light. Next, a thin piece of glass is placed in the optical path of the telescope. This absorbs all the planetary heat, but transmits the reflected solar radiation. Since the distance of the planet and the area of the surface which is sending heat to the thermocouple is known, the temperature can be calculated from the amount of radiation which is sent us per unit area. The most uncertain part of the calculation lies in the correction which must be made for losses when the rays are passing through the earth's atmosphere. Atmospheric conditions on the planets are so different from those on the earth that the actual temperatures such as would be read if a thermometer were placed near their surfaces might differ greatly from those obtained by radiation methods.

Mercury is certainly very hot and has little if any atmosphere. The maximum temperature is about 700° C. absolute (800° F.). The distribution of radiation over its surface is much like that of the moon. Venus is covered with clouds. The radiation measured is from the high cloud surfaces and tells very little, except by inference, about the actual surface temperatures. The night temperature at this high altitude in the atmosphere of Venus is much greater than that on the surface of Mercury or the moon, being about 250° C. absolute (—9°F.). The temperature of Mars varies greatly with the season and the time of day, but the temperatures there are somewhat like those on the earth, at least like those at very high elevation where the atmosphere is rare. The outer planets are very cold, as might be presumed from their great distances from the sun, unless they give off heat from their interiors. Not many years ago it was commonly supposed that Jupiter was warm, probably warm enough to give out some light of its own. The thermocouple, however, shows that this is not the case, and that the temperature of Jupiter is about 135° C. absolute (—216° F.).

The absolute temperature of a theoretically "perfect radiator" varies as the fourth root of the total radiation emitted by it from a unit area of its surface. The moon, strictly speaking, does not behave as an ideal radiator would, but for practical purposes it may be regarded as such. The measurements of the total lunar radiation, therefore, lead directly to estimates of the moon's temperature. From numerous observations during the last seven years, the temperature at the point on the moon where the sun is directly overhead has been found to be 118° C. (244° F.) at the time of full moon, and 65° C. (149° F.) at first and third quarters. The difference in these results, apparently, is caused by the roughness of the surface, which increases the radiation sent out in the direction of the lunar zenith and decreases that emitted toward the horizon. The true temperature lies between the figures given. Measurements made on the dark side of the moon gave —153° C. (—243° F.) for its approximate temperature. An accurate determination for this part of the moon will, however, require extensive observations, for the lowest temperature which can be detected with the instruments used (approximately —170° C. or —274° F.) is not much below that indicated by the observations thus far made.

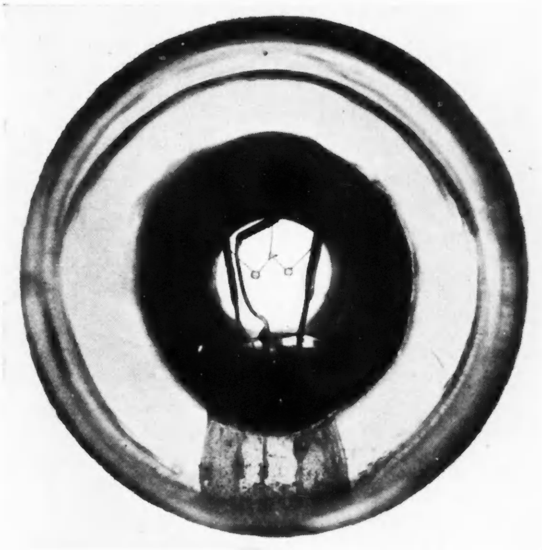
The variation in the radiation, and hence in the temperature, over the sun-lit side of the full moon was obtained by allowing the image of the full



THE WORLD'S MOST POWERFUL TELESCOPE.

The thermocouple is mounted on a hundred-inch telescope and is so sensitive that astronomers have been able to measure the heat of a star of the thirteenth magnitude.

moon to drift across the receiver of the thermocouple while a moving photographic plate traced the resulting galvanometer deflections. The planetary heat varies from a practically unmeasurable quantity at the edge to a maximum at the centre. The changes in temperature which take place during a lunar eclipse were investigated at the eclipse of 14th June, 1927. For the point measured, the temperature fell from 69° C. (156° F.) to —98° C. (—144° F.) during the first partial phase, continued to drop to —117° C. (—179° F.) during totality, and during the last partial phase rose abruptly nearly to the original temperature. The enormous fall in temperature of 186° C. (335° F.) observed during this eclipse, the greater part of which took place during the partial phase, is in strong contrast to the fall of 2° or 3° C. (4° or 5° F.) observed at solar eclipses on the earth.



THE EYEPIECE.

An enlarged view of the eyepiece of the thermocouple showing the metal discs upon which the heat rays of the stars under examination are focussed.

This illustrates the governing effect of an atmosphere on planetary temperatures, since the only physical distinction between the factors involved in this comparison is the absence of an atmosphere in the case of the moon and its presence in the case of the earth. It happens that the radiation from the sun runs to shorter wave-lengths than the radiation from the earth. It happens, also, that short waves go through our atmosphere more easily than long waves do. This is because of the presence in the atmosphere of carbon dioxide and of water vapour, both of which serve to differentiate wave-lengths. So our atmosphere acts as a sort of trap for heat-rays, letting in easily those from the sun and holding back those from the earth. Thus, the excessive cooling, which otherwise would take place at night, is prevented.

There is much more to be learned about the planets and the moon from thermocouple measures. It is quite probable that the observed rates of cooling and heating of the moon, as the amount of sunlight which falls upon it varies, may lead to very definite knowledge of the character of the rocks of which its surface is composed. In fact, laboratory study has already been made upon various earth materials—granite, lava, quartz-sand, and pumice, among others—heating and cooling them, observing the rates at which their temperatures change, and comparing the results with the rate of change which takes place on parts of the moon's surface as shown by the thermocouple. In attacking the problems presented by the surface features of the moon, a committee of scientists in America is seeking to ascertain the nature of the materials exposed at its surface and their behaviour under lunar surface conditions. When this information has been obtained, the committee expects to proceed to the classification of the surface features and to the analysis of the several hypotheses which scientists have advanced to account for them.

A National Folk Museum?

In *Discovery* for September an appeal was made for the preservation in a National Folk Museum of buildings of earlier periods and their contents. It was then pointed out that, unless such a collection were established, objects of value were likely to be thrown aside as rubbish to decay, when those who valued them had gone. It is now announced that the Government is considering the erection of a museum in the Royal Botanic Society's gardens in Regent's Park, where typical old cottages would be erected to house collections of period furniture and utensils. A committee has already been formed to consider the suggestion, which was made some time ago by the Royal Commission on National Museums. The Botanic Gardens has been suggested as a suitable site by a committee of the British Association and the Royal Anthropological Society, and it is understood that Mr. Lansbury has received the proposal favourably. When the Royal Botanic Society's lease expires two years hence, it will not be renewed.

British Universities To-day : (9) Manchester.

By Sir Alfred Hopkinson, K.C., B.C.L., LL.D.

Vice-Chancellor of the University of Manchester, 1900-1913.

The foundation eighty years ago of Owens College, which later developed into the Victoria University of Manchester, marked the commencement of the modern university movement in provincial towns. The close co-operation of teaching and research has been an important feature of the University since its inception.

THE University of Manchester is really a development of Owens College, and the date of its foundation should be taken as 1850, when the scheme for carrying out the will of John Owens was completed, ready for the actual opening of the College on 12th March, 1851. The existing corporate body, however, of which the correct legal title is now "The Victoria University of Manchester," dates from 1880, when the first Royal Charter for the University was granted. It was right, therefore, that when the Jubilee commemoration was held in May of this year, the eightieth anniversary of the foundation of Owens College and the fiftieth anniversary of the grant of the University Charter should be celebrated together.

Foundation of Owens College.

The idea of a new university in a large town goes back to a date much earlier than the middle of the last century, for in 1640 a relative of General Fairfax drew up a petition praying Parliament that a university might be founded in Manchester. Objections were raised in York and the Fairfax proposal was not carried out. Another attempt was made late in the eighteenth century to found a "College of Arts and Sciences" with the help of the Manchester Literary and Philosophical Society, which has done so much to promote scientific research in Lancashire. At that time the population of Manchester appears to have been only about 36,000. A medical school, now incorporated with the university, was actually instituted in 1825. But the really effective start of the modern university movement in large towns, except London, was due to the action and wise forethought of John Owens, a Manchester merchant, and his friend, George Faulkner. It is said that John Owens, who was a bachelor, proposed to leave his whole fortune to his friend, but Faulkner said that he had already plenty of money and suggested to Owens that he should found a college. Owens felt keenly the disabilities under which Nonconformists were then suffering as regards education ; but there is reason to believe that the scheme for the College was due to both friends, and certainly Faulkner, though a Churchman and a Tory, shared in carrying out the intentions of Owens to found a college on an undenominational basis. Owens died in 1846 and his residuary estate, which was to be devoted to the foundation of the College, amounted to £96,954.

The wise forethought shown in the provisions of his will pointed out the true lines on which the colleges, which were the pioneers of new universities, should act if they were to succeed and the nature of the ideals they should put before them. His endowment was to be to provide (or aid) "the means of instructing and improving young persons of the male sex of at least fourteen years of age" in such branches of learning and science as are usually taught in the English Universities, but subject to the two following fundamental immutable rules and conditions : "that the students, professors, teachers and others connected with the said institution shall not be required to make any declaration as to or submit to any test of their religious opinions, and that nothing shall be introduced in the matter or mode of education or instruction in reference to any religious or theological subject which shall be reasonably offensive to the conscience of any student or of his relations, guardians or friends."

It was at one time thought that this clause forbade any instruction of a theological kind and even lectures on the languages of the Old and New Testament, but after legal advice had been taken, a course of free lectures was given every year by Dr. Greenwood on the Greek Parliament, and the first principal, Dr. A. J. Scott, gave addresses on religion in relation to the life of the scholar. In 1904, after the grant of the existing charter of the university, a free theological faculty was instituted in Manchester, which has been most harmonious and successful and forms a model for action of similar character in other places.

One of the most valuable conditions laid down by John Owens was that his gift was not to be spent

on buildings, but on making provision for a proper teaching staff: and when the work of the College was started, an old house at the corner of Byrom Street in Manchester, which had once been the residence of Richard Cobden, was taken for it. The number of the students was very small and actually diminished after a short time, but the quality of the teaching staff was excellent. It was thus possible to weather the period of depression, whereas, if the money had been spent in buildings, they would probably have proved useless and been disposed of for some other purpose, and thus permanent injury would have been done to the modern university movement. It is worth notice that, when Mr. H. O. Wills gave over £100,000 for the University of Bristol, he directed that the money should be applied for the endowment of chairs to secure proper teaching of university character. Buildings on a magnificent scale, given by his son, followed some years afterwards in due course.

"Learning" as well as Science.

It was also a wise provision which directed that the subjects taught at Manchester were to include "learning" as well as science, making it clear that the founder's object was not to endow a technical institute or a college limited to natural science. From the beginning, the arts side received equal attention within the college, although in the eyes of the general public its work in natural science attracted more notice, as the older universities at that time did comparatively little either in teaching or research, for experimental science. The first four Principals and also the present Vice-Chancellor were "Arts" men. It was largely due to the steady work of Dr. Greenwood, the second Principal, that the number of students rose from 33 in the early 'fifties to over 1,000 day students in 1900. Though no doubt many came very imperfectly prepared, the tone was good, the students were warmly attached to the college and their teachers, and long before the grant of a University Charter many who attained highest distinction had been trained in the college. Among other names of students going back to the period before the Charter of 1880 may be mentioned William Broadbent, Thomas Barlow, Norman Moore and Julius Dreschford in Medicine; and John Hopkinson, Horace Lamb, J. J. Thomson and J. H. Poynting in Mathematics. The work done in chemistry was perhaps most remarkable, from the days of Frankland, the first professor, who was followed by Roscoe and Schorlemmer, down to the present time. For many years a large number of the professors and lecturers of chemistry, both in England and Dominions overseas, were trained in the Owens College laboratories.

Before 1870 the College had quite outgrown the old building, and a movement was set on foot for acquiring a new site and for erecting new buildings. No help could then be obtained from the Government or local authorities, but a site was acquired, of which the less said the better, and a portion of the present buildings was opened in 1873. About the same time the old Manchester Medical School was incorporated with the College and the Medical School buildings were erected. The work went on continuously. The age for admission was raised from fourteen to sixteen. Those who wished to obtain degrees sat for the London University examinations, which had been opened to all candidates whether they had received academic training or not. But the position was felt to be unsatisfactory, and a movement was set on foot, headed by H. E. Roscoe, A. W. Ward, J. E. Morgan and Dr. Greenwood, then Principal, to obtain a Royal Charter incorporating the College as a University with the power of granting its own degrees. Opposition came from Leeds, where the Yorkshire College of Science, which has now developed into the University of Leeds, had for some time been working successfully, and also from Liverpool. The result was the grant of a Charter to the "Victoria University," having its seat in Manchester, with provisions as to the admission of colleges in other places. Liverpool and Leeds were soon afterwards included in one degree-giving body.

A New Charter Granted.

The nature of the instruction given and the character of the teaching staffs of the colleges were not changed, but the recognition thus given no doubt aided the development of all. Each college continued to do its own work, but the regulations as to degrees and the conduct of examinations were entrusted to a federal body which worked well on the whole for many years. Good accounts of the foundation and growth of the College will be found in a "History of Owens College" by the late Alderman Joseph Thompson, a member of the Council for many years and sometime Chairman, and also in an admirable statement prepared for the College Jubilee in 1901 by Mr. P. J. (now Sir Philip) Hartog, to which everyone who wishes really to understand the position and work of the Manchester College at that time should refer. Even before 1900, however, a strong local feeling arose in Liverpool that the position of that city and its college in the University was unsatisfactory and that Liverpool should have a separate university of its own. To maintain the

federal University in face of this feeling became impossible, and many people in Manchester, including influential members of the teaching staff, also desired a change which should give greater freedom of action. After some controversy, a strong judicial committee of the Privy Council decided, in 1902, that new charters should be granted. It would take too long to set out in detail the steps then taken and the actual results obtained. Those who desire to know how the existing charters came into existence and how the present position was brought about will find the facts stated, I believe, for the first time, in Chapter IX, Section 4, of my recently published book " Penultima."

What was done in 1902-3 was not to found a new university in Manchester; neither the character of the teaching nor the position of the staff was changed. The old corporate body was continued and the old graduates, whether they had come from Manchester, Liverpool or Leeds, remained members of it. The new Charter, in fact, states that " The Victoria University constituted by the Charters of Her late Majesty should thereafter be called and known as the 'Victoria University of Manchester,' and shall *remain* and *continue* one body politic." Shortly after, an Act of Parliament was passed incorporating the Owens College with the University and transferring all the property of the College to it. No doubt, the result of the change, nearly thirty years ago, has been on the whole beneficial to Manchester and Leeds as well as to Liverpool. The charters give to women the same rights and status as men in the University. This is, perhaps, the most important departure from the provisions laid down by John Owens.

The University Buildings.

The most important buildings now belonging to the University are the main block in Oxford Street, which includes the main college building opened in 1873, the Beyer Laboratories for Natural History, the Manchester Museum, the Whitworth Hall and the Christie Library. At the back are the Chemical laboratories, the Medical School and the Botanical Laboratory. The Engineering and Physical laboratories are across a street (now closed) on the north side of the old site, while the new Arts buildings, the Students' Unions and the gymnasium are beyond another street on the south, and the Public Health Department is a quarter of a mile away. Definite provision for practical instruction in medicine and surgery is made in the Royal Infirmary, which is quite near, and for gynaecology and obstetrics in the St. Mary's Hospitals. The work of the Faculty of Technology is carried on in the elaborately-equipped Technical School erected by and belonging to the City Corporation.

On 1st November last year the number of students enrolled for the session was 2,581, of whom 664 were women. In the Faculty of Medicine there were 649. Of the total number of students 781 came from Manchester and the suburbs, others from various parts of the United Kingdom and all parts of the world; 59 were from India. It would be wrong, therefore, to regard the University as being simply a " civic " university. It has strong local associations and enjoys support from the City and other local authorities in the district, but is free both from municipal and state control, though deriving the great and increasing financial assistance both from local authorities and the Treasury, and recognizing that without this assistance its work could not now be effectively carried on or developed.

An Example Set by Manchester.

The example set in Manchester no doubt acted as a stimulus to the foundation of the university colleges in other large towns, and six of these have since received university charters. Within about ten years, between 1871 and 1881—the period in effect between the removal of Owens College to its present site and the grant of the first University charter—the increasingly active interest taken in higher education was shown by the establishment in Newcastle of the Armstrong College in 1871, which now forms the home of the Science Faculty of Durham University, followed by the foundation of the Yorkshire College of Science in Leeds in 1874, the Mason College in Birmingham in 1875, the University College in Bristol in 1876, the Firth College in Sheffield in 1879, and the University College in Liverpool and the University College in Nottingham in 1881. Since that date, university colleges have been established in Reading, Southampton and Exeter. At first, special stress was in most places laid on the science side in some cases to the exclusion of arts subjects. In Wales the university college movement was marked by the foundation of the Aberystwyth College in 1872, and the Colleges at Bangor and Cardiff in 1883. All are now included in the Federal University of Wales. They appeal specially to strong national feeling in Wales, but in many respects resemble the colleges in the North of England and the Midlands.

The fact that the special eminence of certain teachers and the special facilities given for certain studies drew many students from a distance led to the establishment of halls of residence. This was essential for the welfare of students who could not reside in their own homes, and effectively promoted real social

MANCHESTER UNIVERSITY FROM THE AIR

life in the Colleges. Manchester now possesses several such halls, the earliest and largest being the Dalton Hall, made possible by the action of the Society of Friends, the Hulme Hall for men, erected with the help of funds derived from an old Trust, and the attractive and growing Ashburne House for women. The University also possesses spacious playing fields.

It has been a marked feature of Owens College and the University in Manchester from the outset that teaching and research must go together. The spirit which leads to the undertaking of valuable original research and to effective teaching being given to students is usually found in the same persons, but it is not invariably the case. The so-called provincial universities show a splendid record both of original work and of successful teaching. It is sufficient barely to indicate how wide its range has been by merely enumerating a few names out of many who have been members of the teaching staff in Manchester, such as Balfour Stewart, Arthur Schuster, Ernest Rutherford and William Bragg, junior, in physics; Frankland, Roscoe, Schorlemmer, H. B. Dixon, W. H. Perkin and C. Weizmann in chemistry; W. C. Williamson, Boyd Dawkins and T. H. Holland in geology and palaeontology; Jevons, Adamson, Alexander, Chapman and Unwin in philosophy and economics. The list might be almost indefinitely extended if names on the arts side, especially in history, were added. The school of historical study, with which the names of A. W. Ward and T. F. Tout were specially associated, has produced important contributions to knowledge and has trained a number of devoted historical students.

Extensive Activities.

The activities of a university in a large city such as Manchester are not confined to its primary duties, first, of training its own students to be fit to serve in Church and State in the widest sense of both terms and incidentally to earn their own living; and, secondly, of adding to knowledge. They may also be extended so as to exercise a useful and stimulating influence on the intellectual life of the districts in which they are placed. The extent and importance of the "extra-mural" work of Manchester University may be gathered from the Vice-Chancellor's statement in his report for the session 1928-29 that forty-nine tutorial classes had been held in the city and many of the large towns in East Lancashire, that with the help of the Carnegie Trust the Central Library for external students was rendering constant service, that twelve university extension courses were given either in the University or at centres outside Manchester, and that, under a scheme of co-operation with the Education Committees of the Lancashire and Cheshire County Councils, many lectures had been provided for teachers and the public.

Lectures, demonstrations, and other educational work done in the Museum, which is included among the University buildings, show encouraging results. Children from elementary schools regularly visit the Museum under proper guidance. Perhaps most valuable of all is the co-operation between the University and the magnificent Rylands Library in affording opportunities for advanced study, both to members of the University and to scholars from a distance, as well as in providing public lectures, many of which are original contributions of highly valuable knowledge. Mrs. Rylands from the outset attached great importance to this close co-operation.

The University Press.

It is impossible to mention all the extra-mural service rendered, but the work done by the University Press cannot be omitted. In many respects it is similar to that conducted on a larger scale by the Clarendon Press at Oxford and the Pitt Press at Cambridge. It secures the publication of learned works which might otherwise be lost, and also of information relating to the University of special interest to its members. Co-operation with other institutions engaged in educational work in the widest sense has been the keynote of the policy of the University.

Lastly, under the provisions of the Charters of the Northern Universities, a Joint Matriculation Board conducts and controls the Matriculation examination required for candidates in all the Faculties or in any of them. This examination is accepted by most professional bodies, and thus has the advantage of avoiding the inconvenience of duplicating examinations and also of maintaining a uniform and high standard for those who are entering on courses for degrees.

The Charter provides that, for all the other examinations, at least one external and independent examiner shall be appointed "for each subject or group of subjects required for university degrees." While aiming at complete independence for the new universities in teaching and in developing on the lines each finds desirable, it was felt that some safeguards were required to secure the maintenance of a uniformly high standard for all. This is specially important in the case of degrees in medicine which confer the right to practice. The Colleges have gained the right "to brand their own herrings," and it is the interest of all to maintain the value of the brand.

Recent Discoveries in Archaeology.

So many important discoveries are recorded in archaeology that it is possible to deal with only a few of them in full-length articles. These notes will be followed by others in which outstanding topics are discussed.

Distribution of Early Man.

In the October issue of *Discovery* (p. 346), reference was made to Mr. Leakey's investigations in the prehistory of East Africa, which go to show that the stone-age cultures of Kenya are to be grouped in relation to pluviations, and that the character and relation of the geological deposits point to two major periods of heavy rainfall in prehistoric times. It is suggested further by Mr. Leakey that these two pluvial periods are to be correlated with the glacial epochs of the Pleistocene age in Europe. The question of the relation of glacial and pluvial periods in prehistoric times was also the subject of a joint discussion between the anthropological, geological and geographical sections at the Bristol meeting of the British Association, in which a number of workers from various parts of the world took part. Geological evidence was adduced from the Faiyum (Misses Gardiner and Caton-Thompson), South Africa (Mr. Leslie Armstrong), India (Mr. L. A. Cammiade), Palestine (Miss Garrod), and China (Professor G. Barbour), in support of the view that two pluvial periods had occurred in each of these areas which might reasonably be equated with the pluvial periods of East Africa and correlated with the glaciations of Europe in the Pleistocene age, one falling early, between the Gunz and Mindel glaciations, the later between the Riss and Würm epochs of maximum spread of ice.

In this connexion attention may be called to an interesting article in *Antiquity* for September, in which Mr. Miles C. Burkitt and Mr. L. A. Cammiade deal with the evidence bearing upon the stone-age in South-east India afforded by the laterite of the Coromandel coast and the Eastern Ghats. The laterite, which is a composite deposit formed from the detritus of various rocks and requires a heavy precipitation for its formation, provides evidence of two pluvial periods with an arid period intervening. Four stone-age cultures are distinguished which are brought into relation with the climatic changes shown by the laterite. Of these cultures the first is marked by the occurrence of large stone hand-axes of a type similar to that found in Africa, and especially at Victoria West in South Africa. In commenting on the relations of the remaining three cultures to those of Africa, the authors suggest, in view of the linking up of stone-age cultures from South Africa to Palestine, that India may be on the periphery of an area of distribution of Upper Palaeolithic man.

A Philippines Discovery.

Evidence bearing upon the distribution of early man from various parts of the Old World grows steadily, and suggests that we may be on the eve of a momentous extension of our knowledge of the early phases of man's history. Palaeolithic implements which the geological evidence assigned to the quaternary age were discovered in China only a few years ago, and now news is to hand of an important discovery in the Philippine Islands. During the last three years investigations on and near a village- and cemetery-site on the banks of one of the rivers has produced an enormous number—some thousands—of archaeological specimens of varied age. Among these are a large number of stone implements, some of which are said to be, possibly, Mousterian. Until further and more precise details are to hand judgment must be suspended; but the find would seem to be of first-rate importance.

The Peking Skulls.

Professor Elliot Smith, who is now in China, would appear to have been still further impressed by the importance of the Peking Man skulls after having had an opportunity of handling the actual specimens. The second skull, which was found last July in material which had been removed from the cave of Chou-Kou-Tien in the previous October, belongs to the same type as the skull found in December, but differs from it in certain details. The bone is thinner. Dr. Davidson Black is, therefore, of the opinion that the skull found in December is that of an adolescent female while the second is that of a young adult male. In his report on the first skull, after it has been sufficiently cleared of the matrix to permit of something like a detailed examination, he is of the opinion that Peking Man represents a forerunner or ancestor of Neanderthal man—a proto-Neanderthal type. On the other hand, Dr. Hrdlička of Washington, one of our foremost authorities on the skeletal remains of early man, has recently expressed the view that Peking Man is a member of the Neanderthal group.

Interpreting the Secrets of the Jungle.

By G. A. C. Herklots, B.Sc., Ph.D., F.L.S.

Reader in Biology, the University of Hongkong.

A full appreciation of the unusual beauty which is peculiar to the jungle calls for the eye of an artist, the ear of a musician, and the sensitive touch of a craftsman, but a study of the plant life of the Malayan rain-forests, with which this article mainly deals, amply repays the observant botanist.

When visiting a place for the first time, be it oriental town or coral reef, one reacts to the new surroundings and forms mental "first impressions" of the scene. These impressions quickly leave one's memory and, unless notes are committed to paper immediately, the vision fades and is rarely recalled, except, as it were, through spectacles fogged with the facts and theories read in books or discussed by others. The most vivid impression of a first visit to the jungle is the all-embracing silence and stillness, yet the jungle, though silent, is full of sound, though still, is full of movement. Those who have read about the rain-forest, and have seen pictures of it, are profoundly disappointed on entering the jungle for the first time. But coming to the untamed wilds from the civilized world, where man is dominant, requires a tuning of the senses, a quickening of response to sound and smell, a greater delicacy of touch.

First Impressions.

All seems at first to be a drab blur of browns and dull greens, but the observant visitor sees colours before undreamed of, unsullied as though reflected from a rainbow. To appreciate the jungle fully one needs the eye of the artist, the sensitive touch of the craftsman and the ear of the musician. A little scientific knowledge is an aid in the interpretation of jungle secrets; here a millipede, a vegetarian, is enjoying a meal; there a carnivorous centipede is on the war path; snakes and scorpions, fantastic spiders and noisy cicadas all are to be seen if the eye is bright to catch a strange glitter as of gold and the ear is keen to descry the rustle of a leaf.

I had the good fortune to spend five weeks this year in the Malay Peninsula. For the first fortnight the Botanic Gardens, Singapore, were my base, but the remaining three weeks were spent actually in the jungle. These three weeks included a few days on Fraser's Hill, four thousand feet high, on the borders of Selangor and Pahang, and a little more than a fortnight in the Federated Malay State of Negri Sembilan. From Singapore, I visited both mangrove swamps on the island and also the forest covered mountain, Gulong Panti, in Johore, which is seventeen hundred feet in height. So I have seen, if only cursorily, varying types of jungle, from sea-level to a height of four thousand feet. The fortnight in Negri Sembilan was spent in the company of an officer from the Botanic Gardens, and constituted an expedition in so far as we went with the definite object of studying and collecting fungi. Though termed an expedition, our wanderings were never far from the beaten track and we neither camped out nor took with us an army of camp followers; a fortnight only at our disposal was insufficient time to be worth the trouble involved in carrying tents and food, and cutting our way through the jungle to an unknown peak. We therefore stayed for several days at a time at three of the numerous rest-houses dotted about the State, and each day, accompanied by native forest-guards, or coolies, we visited one or other tract of forest-reserve or untouched jungle.

Our wanderings in the jungle were not exciting in the usually accepted sense; we met no elephant, heard no tiger, and disturbed no rhinoceros or wild boar; but jungle is always of fascinating interest, and one is never certain whether a panther may be on the bough overhead, watching intently with eager eye, or whether a python is lying in wait behind a coiled liane, ready to strike at the slightest provocation. Of course, it is impossible to spend much time in virgin jungle without seeing evidence of wild animals, unless the botanist is so keen on his quest that he neglects the zoological side completely.

Unknown Land.

There are 37,000 square miles of forest in Malaya, nearly three-quarters of the area of the country, and the greater portion of this is unknown and unexplored. Here an adventurous botanist has scaled a peak in search of orchids or other plants; he departs, and in a few weeks, the rapidly growing vegetation has obliterated his tracks; or perhaps a forestry officer has roughly surveyed a tract in

search of easily portable timber. But the greater portion remains unknown land, the home of the elephant, seladang, and carnivore.

Special clothing and equipment is, of course, required for jungle work. Clothes must be tick- and as leech-proof as possible; they must be strong enough to withstand the barbs of rattan and the spines of certain palms and lianes, and must be sufficiently porous to let out the water that will inevitably find its way in. A coat is a nuisance. A khaki shirt with short sleeves and khaki trousers tone well with the surroundings and do not make too evident the mud that will soon bespatter them. Canvas boots with studded soles and puttees, well wrapped round the ankles and calves, will discourage the most blood-thirsty parasites. A parang with horn or bone handle and a sharp twelve-inch blade of steel, a camera and stand, a vasculum for the spoil, and an old topee the best protection for the head, complete the equipment. A coolie per man, to help with the specimens and the chopping, is a great aid since it enables one to be freer to examine objects of botanical or of photographic interest.

Early one morning we climbed into a ricketty old car, piled our baggage on the floor in front of us and drove off. Near the edge of the village we picked up a couple of Malay forest-guards, and so proceeded, rattling and creaking up the pass. The road meandered along between fields of newly planted paddy, clumps of dark green sago palms and groups of native attap huts. Presently, we ascended a still more tortuous route. Here by the roadside a giant tree stood solitary, a reminder of the days when all around was the untouched wild. We drove along the edge of the forest and now could observe the characteristic plants which grow where there is abundant light and moisture, and which are never found in the dense shade of the jungle. The banks are covered with the rank growth of *Gleichenia* ferns, and the intricate tracery of the dichotomously branching fronds leave a permanent impression on the memory. Higher up, we noticed an abundance of *Melastomaceous* shrubs with their pink flowers. The colour of the flowers is not very pleasing, neither are the plants particularly graceful. Here was a depression in the ground sodden with water which had percolated through the bank above. Rooted there was a plant of the beautiful flowering climber, *Bauhinea flamifera*, and looking up into the trees flanking the road we could see the sprays of brightly coloured flowers. Bauhineas, typically, have partially or completely bifid leaves; when the leaf is young it is folded so that the two lobes press closely against each other, and hence the Chinese have given them a name meaning "friendly leaved tree." In Malaya, most of the bauhineas are climbers and this species, with flowers yellow on opening and changing later to an orange-vermillion, is abundant in damp places on the edge of the jungle. They do not flourish, however, in the dense shade cast by the giant trees within the forest boundary.

BUTTRESS ROOTS.

The reason for the origin of the huge buttress roots which the giant jungle trees develop is still obscure.

We left the ancient car to be doctored by the "sais" and, accompanied by the forest-guards, entered the forest. Following a path it was rarely necessary to use our parangs, and we were thus able to look around us and to note the spiders on their webs, the fungi, giant polypores, sticking horizontally like brackets from the trunk of some dead tree, and the red *boletus* and pearly-white *amanita* breaking through the leaves carpetting the floor. The particular tract we visited was a forest reserve which had been alienated for some years, and we were particularly interested to observe the methods adopted to conserve the area. The simplicity of the scheme employed is striking. The large timber trees are graded into first and second classes, and the forest-guards are taught to distinguish the species in the two groups by their leaves, or, if the leaves are too far out of sight to be visible, by their trunk, bark and the nature of their sap. A certain number of the first-class trees are removed for timber, but many of the giants are left to produce seeds. The second-class trees are roughly "ringed" two or three feet from the ground and left to die, the younger trees of this class being cut out with a slash of the "parang." Two results of this procedure were at once apparent to us, namely, the abundance of seedlings and saplings of the first grade and the

presence of dead second-class trees standing gaunt and naked, or prostrate on the ground, obstacles in the path to man and beast. Eventually such an area will contain trees of a certain uniformity both as regards quality and size of timber.

In this area, unusually dry at the time of our visit, we saw many interesting plants and animals. One small bush called *Thottea* had amazingly large flowers, purple and white and green ; this plant is allied to the *Aristolochia*, a genus which has even more strangely shaped and coloured flask-like flowers. The spiny "Bertam" palm, a species of *Eugeissonia*, was abundant in the lower regions but, owing to the dryness, rattans were conspicuous by their almost complete absence. A few *Licuala* and *Pinanga* palms were seen, but most of the vegetation consisted of dicotyledonous trees and their seedlings. At the top of a small exposed peak, about fourteen hundred feet high, we found some plants which were much more characteristic of the exposed and arid mountain tops of South China. There were ericaceous shrubs and one of the Myrtaceae, *Baeckea frutescens*, with fragrant aromatic leaves, which is so abundant in Hongkong.

Lower down in the reserve some quaintly shaped and brightly coloured spiders attracted my gaze, and I managed to collect and preserve a couple for future examination. Fungi we found in abundance, especially in the lower and damper regions, and these included many species of interest which we collected or photographed.

Photography in the tropics is no idle hobby, and unless it is pursued methodically and scientifically, the results are usually only fit for the rubbish heap. Both my friend and I took with us double extension cameras with good lenses and shutters, and a stand. We used panchromatic plates and colour filters, and gave long exposures. My photographic experience in Hongkong was of little value, conditions being very different in Malayan jungles, but my friend had experimented considerably and had both systematically recorded his results and classified them. Using his experience as a basis, and recording the details of every exposure, we succeeded in taking a series of excellent photographs. Exposed plates must not remain long undeveloped in the tropics, so on alternate evenings we developed our plates in a tank, using a standard technique, and fixed and hardened them in a special fluid immediately afterwards. When the plates had been washed and dried they were carefully examined through a lens and, if the exposure was thought to have been incorrect, a note was made of the exposure that should have been given. As a result of this somewhat elaborate checking of results, by the end of our expedition we rarely exposed a plate in vain ; that these precautions were necessary is illustrated by the fact that the exposures I gave varied between 1/25th second with a filter to seven minutes using no filter.

A GIANT TREE.

Photographing giant trees is difficult, since it is usually necessary to be at least two hundred yards away.

Another drawback in photographing the jungle, in addition to the great variation in light intensity, is the difficulty of obtaining sufficient space between object and lens so as to be able to include the whole object in the field of view. This difficulty cannot be overcome in the case of giant trees, since one has often to be two hundred yards from the tree in order to photograph it ; giants must be photographed at the edge of a forest clearing. In the case of smaller plants, sometimes three-quarters of an hour's hard chopping with a parang is necessary to clear away intervening saplings and gingers, and this procedure we were compelled to adopt almost invariably in the thick jungle.

On Gunong Angsi, 2,709 feet high, the forest is still virgin, and except for two winding paths—the Sereban Road from the Kuala Pilah and a path from Perhentian Tinggi, both leading to the rest-house near the summit—the place is untrodden by the foot of man. In forests, frequently the man-made paths closely follow the tracks of elephants or other big game. It is therefore unwise to camp on or near a track lest elephants wander along in the night and hurl the camper, his coolies and equipment into the nearest bush. The converse also frequently holds good—that animals make use of man's paths especially if little used by man himself. On the few paths on Gunong Angsi we invariably found fresh tracks of

tapir, but we never saw one of these very shy and wary animals. In one forest, we found an interesting fungus, growing on elephant dung on the path, and collected a specimen. On another day, my friend found a large and magnificent mushroom, which, with difficulty, I carried back intact to the bungalow. "Very good to eat" we told our Malay assistant, but he only smiled and shook his head. He was correct; the flavour of the mushroom was disappointing and not in the least what we had been given to expect by the fragrance of the smell.

There are several things, other than camping on elephant tracks, which it is inadvisable to do in the jungle, and these one discovers gradually as a result of experiences which are not always pleasant. One day in lowland jungle, while my friend was photographing a clump of fungi, I sat down on the path to take a well-earned rest. Presently, I noticed at the bottom of one of my puttees what I took to be a small brown worm. Idly I wondered how it had got there and what it was doing. Later, it began to walk up my leg in the manner of a looper caterpillar, which I momentarily thought it was until it dawned on me that the looper was a leech. Promptly I took a tube out of my pocket and the leech became a specimen.

AN ORCHID IN DENSE JUNGLE.

An important feature of the expedition was the collection of plants, among which were many beautiful orchids.

No account of jungle vegetation, however brief, is complete without some mention of the trees with the curious stilt roots and those with the even stranger buttress roots. Of course, we endeavoured to take photographs of typical specimens of both types. Occasionally one meets with a Pandanus plant with stilt roots, a long slender stem, branched perhaps at the apex, and with a crown of long drooping narrow leaves evilly toothed at the edges. It is no light task to clear a space round one of these plants, in order to take a photo of the stilt roots, attenuated trunk and crown. Other trees with stilt roots are the figs; one frequently meets with such a tree in the jungle and they make interesting photographs. These stilt, or prop, roots of *Pandanus* and *Ficus* are very different from the buttress roots which are developed at the base of many *Dipterocarpus*, *Artocarpus*, and other species of *Ficus* trees. Buttress roots resemble thick planks and are often four or five feet in height at the trunk, sometimes sloping very steeply to the ground at a distance of four or six feet, and at other times tapering gradually. In these cases, the roots are often sinuous and, if a tree develops several, they give it a very uncanny appearance. The reason for the origin of these roots is still obscure, but it is significant that, when trees of these genera are found growing on steep banks, they generally possess well developed buttresses.

One of the most enjoyable glimpses of the jungle's varied life is obtained in the evening. A walk along a jungle path, silently and preferably alone, an hour or so before sunset, reveals a wealth of life whose presence was unsuspected an hour earlier. The cicadas have not yet begun their deafening evening chorus, and thus it is possible to hear distinctly the cries and calls of other animals. In the moist valley below, the grating cry of frog or toad pierces the silence of the forest, and is repeated at regular intervals. A bird is heard, is silent for a minute, then calls again. Both these two cries of frog and bird can be imitated to perfection after a little practice. In the distance, a glimpse is obtained of a gibbon in the tree-tops, and faintly, from still further away, comes the curious whistling cry of another. This monkey whistles the whole scale, slurring two or three notes at a time, and then, having reached the top note and unable to descend the scale but keen to try, starts in the middle, slips down two or three notes, and finally abandons the attempt. A night-jar, on a branch of a tree in the valley below, imitates the clucking of a domestic hen.

Clouds are gathering from the plains below and soon the mountain-top is enshrouded in mist. As I walk back to the rest-house I can see in the distance the dancing flames of a forest fire, where secondary jungle is being burnt preparatory to rubber planting. There is much to be done before bed-time: the day's collection of fungi, mosses, and orchids to be sorted out and examined, negatives to be developed, and notes of the day's experiences to be entered in my diary.

When Wheels Revolve the Wrong Way.

By V. H. L. Searle, M.Sc.

Lecturer in Physics at the University College of the South-West of England.

Why is it that the wheels of a moving vehicle often appear to be moving in the wrong direction when shown on the cinema screen? The stroboscopic method of examination, which is here described, permits a study of this and similar effects of high speed, and enables engineering methods to be tested.

A RATHER curious effect can sometimes be seen in a cinematograph picture showing a moving vehicle the wheels of which have large spokes. When the vehicle is travelling at a good rate the spokes cannot be seen, but when the car or carriage slows up they come into view, and it is at such times that the effect mentioned occurs. Instead of moving round in the correct direction for the motion of the car they seem to go at first rapidly and then more slowly in the wrong direction. Then they come momentarily to rest before beginning to move in the correct way. This is rather confusing, and gives the impression that the car is in reverse with the wheels skidding, except that the driver appears unconscious of the remarkable experience.

Illusions of the Cinema.

This is only one example of the illusions which occur frequently when the cinema camera—operated at the usual speed—takes pictures of rapidly moving objects, and which are due to the fact that a continuous record is not really obtained but only a quick succession of snapshots. Suppose, for example, a cinematograph camera, taking sixteen pictures each second, is photographing a revolving disc upon which is painted a black arrow on a white background, and that this disc is rotating 954 times per minute, that is, 15.9 revolutions each second. The first snapshot would give the result shown in Fig. 1 (*a*). One-sixteenth of a second later the next exposure is made, but in this time the disc has not quite completed its rotation, and therefore is in the position shown at (*b*). The third picture is shown at (*c*) and so on. On presentation upon the screen, these would follow one another at a rate of sixteen pictures per second in the sequence (*a*), (*b*), (*c*), and persistence of vision would merge them into an apparently continuous view of the arrow revolving backwards at a rate of one rotation in ten seconds. If the disc were speeded up to sixteen turns per second, it would appear stationary, while at a rate of 16.1 revolutions each second it would have an apparent rate of advance of one complete rotation in ten seconds. During the slowing up of the wheels of a car, this speed of synchronism is passed through more than once—it will be realized that, if one spoke moves, between exposures, forward to the place previously occupied by the next one, the stationary appearance results—with the effect already described. By regulating the speed of the disc in the experiment outlined above, it will be possible to give it any apparent speed either forwards or backwards, and the consequent slowed-up effect is known as a stroboscopic view.

This must not be confused with the somewhat similar "slow-motion" pictures. To produce these, the camera is made to work at six or seven times its usual speed, so as to take, say, one hundred pictures every second. These are then projected at the standard rate of sixteen per second, and thus all movements are correspondingly slowed to one-sixth of their real speed, enabling details such as the action of an athlete in a sprint race, the finger movements of a conjurer, or the wonderful repetitive motions of a juggler to be studied. There is a reverse process in cinematography—the taking of successive pictures at long intervals with a consequent impression, on presentation, of a great acceleration in the process photographed. This is used for such things as the progress of a plant from seedling to full growth, or the unfolding of a bud into the complete bloom and its subsequent transformation into fruit.

The Stroboscope.

The stroboscopic method of slowing up rapid motion does not necessarily involve the cinematograph at all, and it is a commonplace in the laboratory or the engineering research room. All that is essential is a succession of views of the object to be studied at a rate which differs slightly from that at which the body performs its cyclic movements. Preferably, the time between successive glimpses should be rather longer than the time for one complete movement of the body studied, since in that case the motion will appear to go on, at a much slower rate, in the correct direction, whereas, if the body is rotating or vibrating

more slowly than the frequency of the successive views given by the stroboscopic apparatus, it would appear to go backwards. In any case, for realism, the pictures must follow one another at a rate rather in excess of ten per second, so that the persistence of vision may produce the useful impression of continuity.

The special method used to produce the stroboscopic result will be decided by the circumstances of the particular observation to be made. One common application is the determination of the number of vibrations made each second by a tuning fork, *i.e.*, its frequency. For this, the tuning fork is fitted with two small and light pieces of metal, one on each prong, so that, when the fork is not vibrating, the edges of these come together closing the space between the prongs as shown in Fig. 2 (*a*), where *A* and *B* are the prongs—seen on end —and *C*, *D* are the metal vanes. The fork *F*, Fig. 2 (*b*), is then placed in front of a large circular disc which carries a number of regularly spaced holes *H* and behind the disc, in line with the prong ends, is an electric lamp. If there were always an opening between *C* and *D* and the disc revolved, light from the lamp would shine through each hole as it came opposite the lamp and thus a flicker of illumination would be seen if the frequency of the disc were small, but the flicker would change into a uniform illumination for a rapid rotation. On the other hand, with the disc stationary and the fork vibrating, light could get through only once per vibration. This again would, owing to the persistence of vision, give rise to an apparently continuous admission of light. Suppose, now, that the fork vibrates and the disc revolves. Every time the fork prongs separate there is an opportunity for light to come through, but it can do so only if one of the holes is behind the gap. Therefore, for continuous illumination the disc must revolve at such a speed as to place a hole behind the prongs every time they open. The lowest speed at which this will occur is when the product of the number of holes and revolutions of the disc per second equals the frequency of the tuning fork. In practice a microscope or low-power telescope is directed at the gap between *C* and *D* and, for this correct speed of the disc, the illuminated hole is seen apparently stationary. A slight change in the rotation rate makes the hole move slowly—backward for a slowing up of the disc and forward for an acceleration. Thus, to find the frequency of the fork the disc, which is driven by an electric motor, is gradually speeded up from rest and a revolution counter gives its rate of rotation. This is noted when the holes first appear to be stationary and then multiplied by the number of holes. This procedure is necessary because if the disc were travelling at twice or three times this speed the same appearance would result ; in the first case every alternate hole would be seen at the same place and, in the second, every third hole.

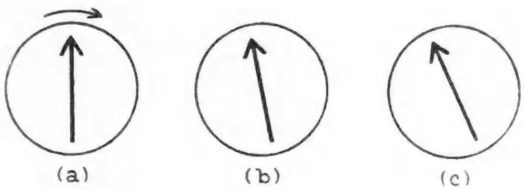


Fig. 1.

If a cinematograph camera were to take a picture of an arrow revolving clock-wise, in the first three exposures the arrow would appear in the positions shown above. Presentation on the screen, however, would show an apparently continuous view of the arrow revolving backwards.

The tuning fork is kept vibrating throughout the experiment by means of an electric battery *E*, which is connected to the base of the fork, and also to a platinum tipped screw *S* which nearly touches a contact *T* fixed to the prong of the fork. From *T* the wire passes round an electromagnet *M* and then back to the base of the fork. If the fork is now tapped, the lower prong moves down, the contact between *T* and *S* is established, and the current flows. This magnetizes the electromagnet, which therefore attracts both the prongs back again with a consequent breaking of the *TS* contact. The current ceases, the magnetism stops, the inward pull on the prongs disappears, and they fly out again to go over the same cycle once more. Thus the fork continues to vibrate as long as the battery is joined in and has enough energy to work the electromagnet.

This is not the most accurate method of measuring the fork frequency. For example, a small mirror may be fitted to the fork prong and thus cause a vibrating spot of light to move transversely across a rapidly moving cinematograph film. This produces a wavy trace of which one wave corresponds to a complete vibration of the fork. If, in addition, another spot of light is moved over the film by means of a second mirror fixed to the pendulum of an accurate clock, it is comparatively simple to count, on the developed film, the actual number of vibrations made by the fork in one second. It follows, therefore, that the stroboscopic experiment is more exact when used in the reverse order, that is, to use the accurately known frequency of the tuning fork as a revolution counter. To do this, the moving mechanism to be regulated at a fixed speed is examined through the prong gap and adjusted until

it appears always stationary. A very slight change in the speed will then cause a slow apparent movement in the mechanism.

There are disadvantages in this method. In the first place, it is not easy to know if the speed for the stationary position is equal to one, two, three, or more times the speed of the fork, and, secondly, the measurement applies only to these special rates. To avoid these difficulties, a variation of the experiment may be adopted in which a viewing disc is used. This is attached to the body whose speed is to be measured, and which carries a series of geometrical figures such as a thirty-pointed star, a hexagon, a pentagon and a square. Certain figures will be seen to be motionless for one speed, others for a different speed, and so on. For example, at a rate corresponding to five-twelfths of the frequency of the fork, the thirty-pointed star is seen doubled—*i.e.*, with sixty points—the hexagon also is doubled, while the square is tripled. Thus, by observing the appearance of the stationary figures—the others being, of course, blurred—a large variety of speeds can be measured and, if necessary, kept uniform, while small changes from these can be measured and adjusted by noting the rate at which the consequent slow motion goes on.

Continued observation through the gap of the forks is not easy, and so, to make the experiment more comfortable and convenient, this gap method of viewing is replaced by a flashing light. Suppose the tuning fork as it vibrates is made to actuate a second pair of platinum contacts and thus to cause an intermittent current to flow in a second circuit. This current, entering a transformer, produces a correspondingly changing high voltage which is applied to a neon lamp. The lamp then flashes once for each vibration of the fork, and these rapid bursts of illumination give sufficient light to illuminate the disc. It will be realized that any special appearance seen through the fork gap will now be obtained from any point of view, since the stroboscopic illumination is obtained by the intermittence of the light itself instead of being caused by the interruption, by the fork, of the steady light from an electric lamp.

Another experiment which can easily be fitted up to demonstrate stroboscopic vision concerns ripples on the surface of a pool of mercury. If the screw *S* of Fig. 2 (*b*) is replaced by a pool of mercury, and the contact *T* by a platinum wire fixed to the fork prong and projecting downwards, electrical contact will be made every time the wire dips into the mercury. The consequent agitation of the liquid surface causes a series of ripples to spread continuously from the point of disturbance. They travel too rapidly to be directly observable, but every time the wire leaves the mercury a small but brilliant spark occurs. These sparks will have the same frequency as the fork, and they will thus occur when the newly formed ripples are in a particular position. Therefore the wavelets appear stationary, their formation can be studied in detail, and, from a measurement of their wave-length or distance from crest to crest, the important quantity known as the surface tension can be calculated. A similar observation may be made on the ripples produced in different liquids by using a neon lamp as illuminant.

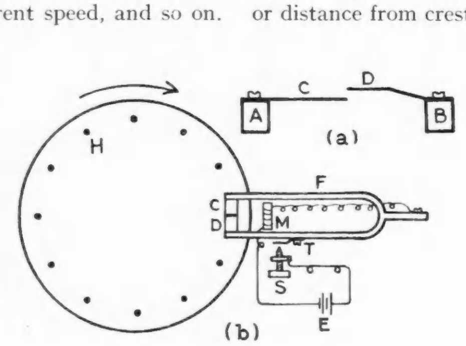


Fig. 2.
A common application of the stroboscope is the determination of the number of vibrations made each second by a tuning fork, fitted with two pieces of metal shown at C and D.

An accurate measurement, and check on the constancy, of the alternating mains frequency can be made by means of a tuning fork and a neon lamp. The lamp, when placed into an ordinary bulb socket, flashes with the same number of cycles as that of the supply. This is usually stated to be fifty per second. Now suppose the lamp illuminates an electrically maintained 50-cycle tuning fork. It ought to appear to be motionless, but it will generally be seen going slowly through its vibration. This shows a divergence between the two frequencies and, since that of the fork can be obtained accurately, that of the mains can be calculated. If, for instance, the fork is seen to make one complete movement in five seconds, then the mains will have completed either 249 or 251 cycles in the same time or their frequency is either 49.8 or 50.2. To decide between these possibilities the fork may be lightly loaded or touched. This will slow down its motion slightly and will bring it more nearly into unison with the mains if their frequency is 49.8. Thus, if the light load on the prongs causes the apparent motion to be slowed up still more, then 49.8 is the correct mains frequency. Usually the electric supply alternations are not quite constant, and therefore the apparent motion of the fork will occur at varying speeds. By repeating the observations to cover the quickest and slowest of these, the range of mains frequencies will be known.

In engineering practice, it is the slow motion property of stroboscopic vision which is most useful since this allows machinery to be examined when it is moving at a rate which precludes observation by other means, and it will be appreciated that effects may appear at high speeds which are absent at lower rates of motion. For example, the valves of a motor-car or motor-cycle engine are made to move up and down by being pushed up by tappets which are operated through cams on the camshaft, and returned to their seatings under the action of the valve springs, which have been compressed by the rising tappets. The quickness of this return depends on the speed with which the springs can relax when the pressure on them is removed, and, at high speeds, there may be too long a time taken in this return for the most efficient working of the engine. In addition, the valve at the end of its tappet's upward travel has a great speed, and it may thus be caused to jump out of contact. On its subsequent return, valve stem and tappet will meet with great force which may cause a rebound. These results would not occur at slower speeds, and their occurrence will decidedly affect the power generated by the engine and thus its efficiency.

Practical Tests.

The stroboscopic method of examination permits a study of these and similar effects of high speed, and also enables the utility of preventive measures to be tested. For such tests some rotating member—for instance, the camshaft—carries a toothed wheel which has, say, 99 teeth, and this engages in a second sprocket with 100 teeth. The latter carries a rotating contact so as to light a neon lamp once per revolution. This means that the camshaft has, meanwhile, made 1.01 revolutions. Thus, each view of the moving parts given by the lamp's intermittent light is one-hundredth of a cycle later than the previous one, and so the whole cyclic movement is seen to be performed at a speed one hundred times slower than its real rate. For example, if the camshaft is making 6,000 revolutions per minute, the valves, springs, and tappets are seen moving at the comparatively leisurely rate of one complete motion every second. If the two engaged wheels had 999 and 1,000 teeth respectively, the slowing up would be one thousand times.

It will be seen that the stroboscopic method of experiment is full of interest, and is sufficiently flexible for use in a wide variety of circumstances, in some cases providing an adequate, accurate, and fairly simple means of carrying out observations which cannot be made by any other direct means.

Correspondence.

BRITISH ASSOCIATION'S CENTENARY APPEAL.

To the Editor of DISCOVERY.

SIR,

The British Association for the Advancement of Science has recently concluded a most successful meeting at Bristol, at which discussion has taken place as to the arrangements for the Centenary Meeting, to be held in London, with the gracious approval of H.M. the King, patron of the Association, and under the Presidency of General Smuts.

The Association during its first century of existence may claim to have established itself, first as a national, and more lately as an Imperial institution. Its Council is of opinion that, despite the steady support which it receives from its members, and the generosity of certain individual benefactors, and of those home cities or Dominions, which from time to time entertain it for its annual meetings, the power the Association has acquired for the advancement of science might be far more effectively exercised if it possessed a larger endowment. The Council would be loth to risk narrowing the present wide field of membership, and therefore of interest and usefulness, by increasing the subscription for the Annual Meeting, though that still remains at the figure of one pound at which it was fixed in 1831, and has even been recently reduced to half that sum for junior student members. The Council has therefore decided to appeal for a Centenary Fund of £40,000.

A first charge upon that fund or the income from it must be the expenditure appropriate to the fitting celebration of the Centenary itself. In this connexion it is the object of the Council to make the Centenary Meeting an occasion for the gathering of the largest possible representative body of scientific workers from the Dominions, and by this means to repay something of the debt which the Association owes to those Dominions whose hospitality its members have enjoyed. Beyond this immediate object the Association earnestly desires to maintain and extend its annual financial support of scientific research, to discharge fittingly the trusteeship of Darwin's house at Downe, recently entrusted to it in custody for the nation and indeed for the civilized world, and to assure the means of carrying out its Imperial responsibilities. Its financial constitution has always forced it to live in a measure from hand to mouth.

The contributions towards research from the funds of the Association fluctuate annually with its net balance of receipts over expenditure, and it is therefore often a matter of chance whether the Association is able to support any particular research in accordance with its intrinsic importance. Not infrequently the Association has to count the cost, with too much appearance of parsimony, before accepting an invitation to a particular place, having regard to the prospects of local support. Where the Association is summoned to carry on its public mission, there the Council feels that it should be able to go without question or limitation on financial grounds.

Contributions to the Centenary Fund will be gratefully acknowledged by the General Treasurer, British Association, Burlington House, London, W.1.

We are, Sir, your obedient servants,

F. O. BOWER, *President.*
J. C. STAMP, *Hon. General Treasurer.*
JOHN L. MYRES, } *Hon. General Secretaries.*
F. J. M. STRATTON, }
O. J. R. HOWARTH, *Secretary.*

Prehistoric Monsters.

The following notes describe a new series of photographs just published by Camerascopes Ltd.

UNFORTUNATELY, photography does not go back so far as the days of the diplodocus, and our only knowledge of its bulk and form is derived from the models which have been constructed so patiently from a few bones. So unwieldly are the models, however, that comparatively few are able to study them, since they cannot easily be carried about. The obvious substitute, therefore, is a photograph, and this has been carried out very successfully by an ingenious method. Landscapes have been built to conform to the scientific conception of the hunting grounds of prehistoric monsters, and a highly natural conception of the animals and their manner of living is presented. By a study of the formations of the bones of fossilized skeletons, it can be decided whether the animal was mammal, bird or reptile, and the creature's food is ascertainable by examination of the teeth. From such starting points, the body can be reconstructed. These great beasts were remarkable for their lack of brain space, and although some of them reached a length of one hundred feet, their brains were negligible.

The method of constructing the models is interesting. First, a framework of wire and metal is built, conforming roughly to the skeleton of the animal, and this is covered with some material which can be moulded by hand. The muscular system is now worked in, and when all the details are completed, a plaster cast is made. The cast, when dry, is coloured ; and here an element of chance creeps in, for in very few cases have any coloured remains been found with the fossils recovered. Modern forms must be taken as guides. On the other hand, the nature of the landscape is possible from a study of the geological strata and the vegetable fossils found in the vicinity of the bones.

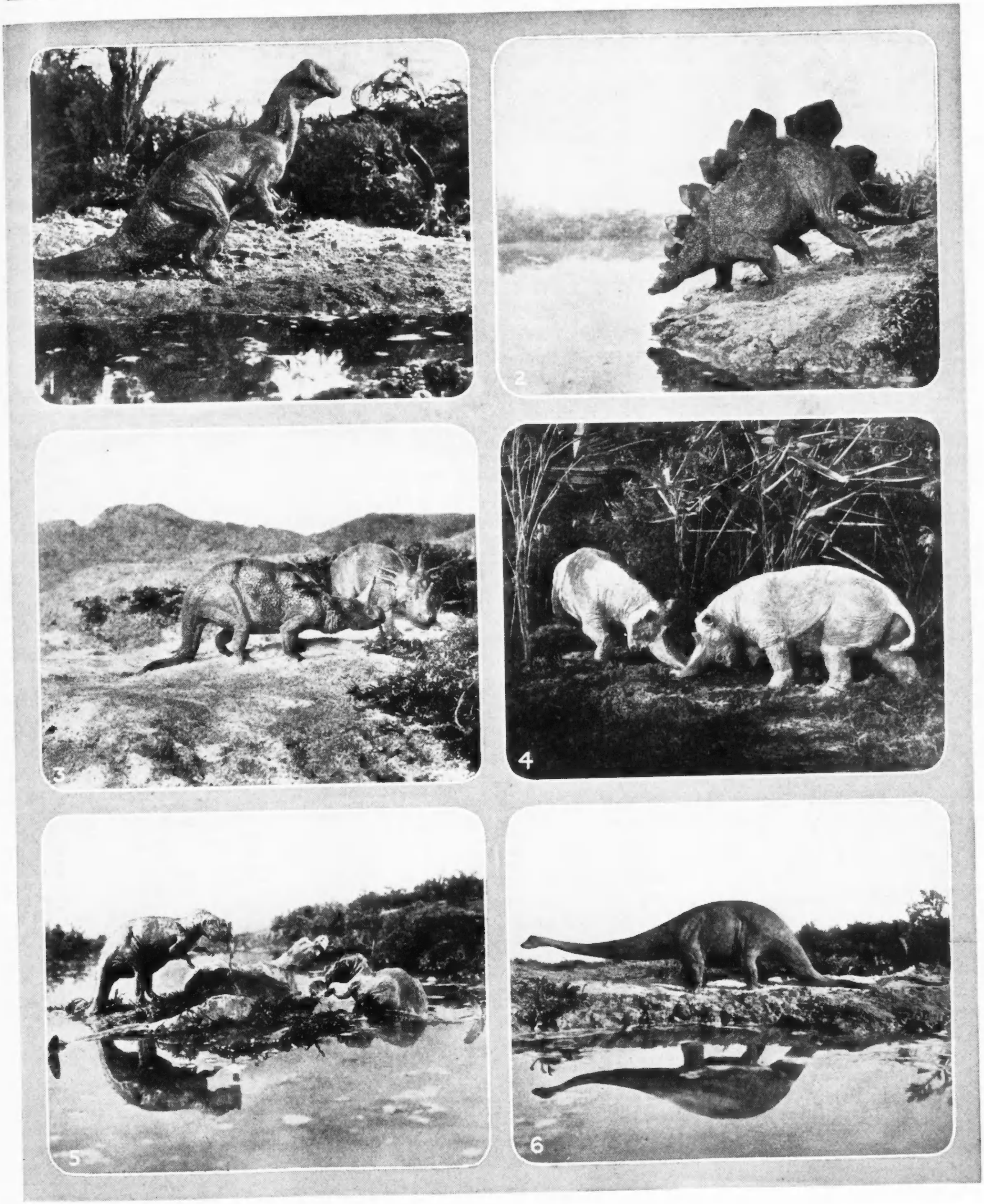
The Iguanodon.

The iguanodon (Fig. 1) was one of the group of dinosaurian reptiles which adopted a biped habit, running on the strong hind limbs and using the fore-arms for tearing vegetation. The feet were three-toed and like those of the flightless birds, while the fore-limbs were four-fingered, one of the fingers being shaped like a spike. From the tip of the snout to the end of the tail measured nearly thirty feet in a large specimen of iguanodon, but much smaller forms have been found. In habits it was generally land-living, but it is thought that it could probably swim and may have fled to the water when pursued. Many of the dinosaurs were armed against the attacks of their predatory contemporaries, and in the stegosaurus (Fig. 2) this armour took the form of bony plates arranged along the backbone and of spikes on the tail. Ossicles and small plates of bone may have occurred on the skin. It is difficult to grasp the significance of all the plates on the back, but some protected the great nervous centre in the sacrum. The spikes on the tail may have been used in defence after the manner of a crusader's mace.

The Upper Cretaceous rocks of Alberta have yielded the bones of the styracosaurus (Fig. 3), an armoured dinosaurian reptile closely allied to the treceratops. It was smaller, being probably only twelve feet long. It is also distinguished by having only one large horn on the nose, and the bony frill over the neck is prolonged into a number of spikes. Like triceratops, it was a vegetarian with a toothless horny beak in the front of the mouth and the teeth at the back of the jaws. It was also very probably an egg layer. The photograph shows a pair disturbed while browsing. The arsinoitherium (Fig. 4), a huge beast the size of a rhinoceros, was among the most fantastic mammals which have ever existed. Over the nose were two massive, bony, sharp-pointed horns, and immediately behind them, over the eyes, two smaller, conical prominences. The whole formed an offensive, and defensive, armament, and figured largely in the contests of the bulls during the rutting season. The structure of the limbs is like that of the elephants in certain respects.

Ninety Feet Long.

The bipedal dinosaurs were of two kinds, vegetable feeders and flesh eaters. The ceratosaurus (Fig. 5) was one of the latter, and derives its name from the short bony horn on its nose. Like iguanodon, it ran on its strong hind limbs, also three-toed, but its fore-limbs were used for tearing flesh and its sharp sabre-like teeth were in the front of the jaws as well as on the maxilla. The diplodocus (Fig. 6) was a gigantic creature belonging to the order of extinct reptiles known as the dinosaurs, and is one of the largest animals known. It attained a length of nearly ninety feet, most of which was taken up by the long neck and the very long whip-like tail. The short head contained a small and lowly organized brain. The teeth were like lead pencils in shape and were restricted to the front of the mouth, where they were most suitable for raking in the plants used as food. As is shown in the photograph, this dinosaur inhabited regions with swamps, lakes or estuaries.



HOW PREHISTORIC ANIMALS APPEARED.

Book Reviews.

The Modern Dowser : A Guide to the Use of the Divining Rod and Pendulum. By LE VICOMTE HENRY DE FRANCE. Translated by A. H. BELL. (George Bell & Sons. 3*s.* 6*d.*).

I approached this book hopefully. Here, I said, is a book which is a guide. It is not going to boast of the great things dowsers do. It is going to tell us how the mysterious operations of dowsing or water divining are done. And the book, I reflected, must be pretty good because it has evidently been worth while to translate it from the French. But my hopes, as the phrase has it, were doomed to disappointment. I had not read far in the book before I realized that it appears to be intended not for the scientific man but for those who are interested in the "occult," and the occult, I ought to say, at its most credulous. I do not wish to be rude, but I have never read greater rubbish on a scientific or a pseudo-scientific subject than the contents of this work. If the author, who appears to be an easy-going, simple and sincere man is right, then the external world known to the physicist and the chemist is wrong ; is, in fact, all wrong.

The author describes how he has gone about with a divining rod or, more frequently, with a pendulum suspended from his fingers and experienced the most remarkable happenings. The pendulum may vibrate in the ordinary way, or it may gyrate either clockwise or anti-clockwise, and the motions may be slow or rapid. This variety of motions the author has correlated with the presence, depth below the surface, and intimate nature of metals, metallic ores, rocks, wines, colours, waters and vegetables. For example, suppose you want to find the chief ore of lead, galena. (Probably you do not, but let us suppose that you do.) You obviously do not want to search the whole countryside looking for a vein of the ore a few feet wide only. So you do this : "Take a pendulum made of a little bag containing ore, a thread and a little stick." After you have settled certain details, "you explore the horizon with the left arm extended. If the pendulum gyrates you have found the general direction of the deposit." Do this at various places and there you are, the deposit you want is found. The book is full of advice of this kind. No doubt the rod does move, no doubt the pendulum does swing, in the author's hands, but the book does not inform us from what source he gets the inspiration which correlates the motion with his clear statements about the amount and nature of waters, rocks, metals, and so on. He sweats conviction on the subject, but what he is convinced about is at total variation with what we know in science. "First of all we find that all edible vegetables give as a rule very few sets of gyrations [with the pendulum]—two or three, representing the qualitative or characteristic series. When you find longer series, say six or seven movements, be on your guard, for you are dealing with poisonous substances. This discovery, which has very important results, may seem at first somewhat extraordinary." Too extraordinary for most of us, I fear, dear author ! Whatever this is, it is not ordinary dowsing.

The remarks on water are revealing of both author and translator. After asserting that the rate of mortality is directly dependent on the supply of good drinking water they continue : "Country people sometimes say that they are indifferent on the subject because they do not drink water. . . . This is a mistaken idea. . . . Water is indispensable not only for man and beast, but is used in great quantities for cooking and washing and for cleaning of all kinds in the house and farm. It is required for bathing by human beings and animals, for watering gardens and for extinguishing fires. The universality of the question is obvious."

A. S. RUSSELL.

A Bird Watcher's Notebook. By J. W. SEIGNE. With Drawings by PHILIP RICKMAN, and Photographs. (Philip Allan. 12*s.* 6*d.*).

Mr. Seigne is one of those sportsmen who have learned that more pleasure can be derived from watching birds than from shooting them. He tells us in his preface that he has given up shooting on his property in Kilkenny, and has made it a sanctuary, chiefly in order to study woodcock.

He believes that two types of woodcock occur in Ireland, the red and the grey ; the former he distinguishes as Irish-bred birds, and the latter (which are slightly smaller and arrive later) as migrants. He gives details of his shooting bags to substantiate his theory, and a coloured illustration of the two types by Mr. Rickman seems to show the difference clearly. The plumage of woodcocks varies greatly, but Mr. Coward, in his "Birds of the British Isles," says that he is unconvinced that British woodcock are darker and larger than migrants. Only an examination of a large series of skins by experts could settle the point.

The book is discursive. Some passages are loosely written, and contain unnecessary repetition. There are three chapters on woodcock and snipe ; others deal with the pintail snipe and an alluring bird haunt in Mongolia, rooks and herons, and regularity in bird-life. Perhaps the two most interesting are those on vermin, one from the point of view of the bird-lover, and the second (written by Major Maurice Portal) from that of the shooting man. It is instructive to compare their conclusions. Neither has a good word to say for the hoodie crow, the sparrow-hawk or the rat. Both agree that the kestrel and the merlin are usually harmless. The worst Major Portal can say of ravens is that they sometimes spoil a grouse drive.

As to the peregrine, Mr. Seigne thinks that its depredations on grouse are rare, and should be pardoned, but Major Portal considers it a nuisance where grouse and partridge are the main stock on a shoot. Magpies apparently came to Ireland from England. Mr. Seigne does not consider this to be yet another Irish grievance, but Major Portal condemns them as inveterate egg-stealers. He is generally benevolent towards owls, except the little owl. The fox Mr. Seigne finds almost harmless in his sanctuary, but Major Portal has shocking tales to tell of his misdoings on grouse moors. His catalogue of vermin is naturally longer than Mr. Seigne's, but if all game-preservers were as discriminating as Major Portal few would find fault with them.

The book contains much first-hand observation. Mr. Seigne once saw a merlin carrying a bird which his keeper insisted was a young grouse. The keeper fired, and the merlin dropped—not a grouse but a young merlin, which it had been trying to carry into safety. He relates several instances of snipe carrying their young, and states that woodcock when transporting their offspring sometimes use the bill as well as the claws and thighs to support their burden. A friend of his who sent a detailed description of a woodcock carrying its young on its back to a distinguished ornithologist, received the "chilling reply" that such a feat was impossible. We know that type of ornithologist ! But, as Mr. Seigne remarks—and he might have quoted Gilbert White in support—one of the principal requisites for the study

of wild creatures is a perfectly open mind. He has heard of two other instances of woodcock carrying their young in this manner.

Mr. Seigne has powers of vivid description of scenery as well as of birds and beasts ; he can make you see the mirage effects on a Mongolian lake whose waters " merged into successive waves of soft blue, until there seemed to be not one lake but a series of lakes hanging and quivering in the air " ; or, on a frosty morning, " the bold outline of distant mountains etched in pink against a saffron sky." His book will be enjoyed both by bird-lovers and sportsmen.

E. W. Hendy.

The Organization of Farming. Vol. I. : " Production." By G. T. Garratt. (Heffer.)

The state of agriculture is prominently before the community at the present time. Few can be ignorant of the fact that arable farming in particular is in the trough of an acute depression, and this fact will be further emphasized during the coming Parliamentary Session when agricultural legislation may well occupy an important position in the Government's programme. Those who wish to be well informed as to the situation should study Mr. Garratt's book, which analyses the position clearly, fully and fairly. It deals, however, with only one of the two main groups of agricultural problems, that of production, the first three chapters being occupied with a consideration of the relative merits of different types and sizes of farms, the next three with national and social considerations, the seventh with landlords, and the last with possible future developments. The examination of marketing problems, the second main group, is deferred to a second volume, which we hope will appear while the present Government's highly important Marketing Bill is still under discussion. Marketing legislation is more feasible and more likely to produce early and beneficial results than an attack on the problems of production.

The agricultural problem is extremely complex. We have, within this small island, so many soils and climates, so many types of farming, so many conflicting interests. An agricultural policy suited to one district and one type of farming is useless in another district. Protection itself is against the interests of those who buy large quantities of imported feeding-stuffs, although the dread of competition from overseas casts a dark cloud over the industry as a whole.

Agriculture is undoubtedly inefficient in many ways, and Mr. Garratt lays his finger on many weak spots. It is argued by some that to bolster up an inefficient industry by means of protective legislation and State aid is unsound, and merely perpetuates this inefficiency, but can increased efficiency come without such assistance ? The industry is so diverse, scattered and unorganized that it is exceedingly doubtful if it can do much to help itself. Admittedly we cannot imagine the land in this country lying altogether derelict. It will prove profitable for some system of farming, but that system may well be against national interests. If agriculture works out its own salvation at present, it will certainly mean increased rural depopulation in the arable districts. If the farm labourer goes, it will be indeed difficult to get him back at a future date, and there is already every indication that many districts will experience a definite shortage of farm labour in the near future.

Mr. Garratt is afraid that his book may appear inconclusive. It is difficult to deal fairly with his subject and be otherwise. Yet he states two conclusions which ought to be emphasized.

(1) " The real crux of the farming situation is the *net*, not the *gross* production per man." With low prices, farmers may go in for " low " farming ; total production is low, but few men are employed, expenses are kept low, and the net production per man employed is accordingly high.

(2) We have many excellent and efficient farmers, but " they are hampered by a land system which prevents them from developing satisfactory and properly equipped farming units." Mr. Garratt, after carefully examining the facts, favours public ownership of land. Possibly the author is inclined to over-emphasize this point. Many able farmers carry on successfully under bad landlords, and farming is such an old industry that in the great majority of cases farmers work on systems well adapted to their various special local conditions. We must also remember that we still have large numbers of well-managed and wealthy estates—although ruinous taxation is steadily reducing their numbers—and in many of these cases the landlord does considerably more for his tenants than any public body could do. It would be a national misfortune to remove this type of landlord.

Rothamsted Experimental Station,
Harpenden. H. G. Miller.

Bird Watching and Bird Behaviour. By Julian Huxley. (Chatto and Windus. 5*s*.).

Professor Huxley's success at making biology comprehensible to the layman has been so conspicuous that his more particular achievement as one of the most brilliant and penetrating of bird-watchers receives too little credit. The emphasis wisely placed on bird-watching in the series of broadcast talks here reprinted should enable his listeners and his readers to appreciate the qualities on which his ornithological reputation must largely depend. In zoological journals his contributions to the elucidation of courtship and related problems are substantial, and it is surprising to reflect that this is the first of his books, by which the wider public must judge, to do anything like justice to his individual experience and general grasp of the contemporary questions of bird-watching. Freed from the limitations of scientific writing he has been able to range untrammelled over his field, and in following his lively concentrated account this remarkable breadth of reference must surprise even those who are well acquainted with his work. How many first-rate observers are there, with a comprehensive knowledge of literature and current work, who could illustrate so aptly a brief survey from their own notes not only in Europe but in America, Equatorial Africa and the high Arctic ?

Anyone who has had the task of phrasing a popular work on ornithology in such a way as to avoid ambiguity or over-statement, while touching on many points about which curiously little is known, will appreciate the skill which has left the present reviewer with only a single detected opening for disagreement in more than a hundred packed pages. In speaking of " the transference of emotion or its expression into unusual channels " Professor Huxley quotes the instance of throwing stones into an osier patch which harbours some sedge-warblers, and continues :—

" On this the cock birds will almost invariably burst into song ; song, the normal expression of sexual emotion and general well-being, has been commandeered as outlet for the birds' feeling of anger."

The necessity of assuming transference is not clear, nor does the definition of the function of song appear to cover all the facts. To take a familiar example, robins sing very intensely

in autumn when there is not only no sexual activity, but the individual intolerance appears as uncompromising between cocks and hens as between old and young or rivals of the same sex and generation. Nor does it account for the familiar poverty of song in, say, a tropical rain-forest, where "sexual emotion and general well-being" may be equally manifest. The territorial theory has its shortcomings, yet in tentatively accepting song as one of the channels through which strong territorial feeling proclaims itself, we are less likely to find the facts troublesome to the theory. For example, in the case quoted, the trespass of man or missile serves equally with the sight or sound of a rival as a trigger to release (at the appropriate season) a burst of territorial emotion. Transference would be a more plausible interpretation of the much rarer phenomenon of male birds in the heat of a scuffle uttering the characteristic song-form of the species.

The illustrations are notably well chosen and well reproduced.

E. M. NICHOLSON.

The Khoisan Peoples of South Africa. By I. SCHAPERA, M.A., Ph.D. (Routledge. 31*s.* 6*d.*).

In this book, which is the first of a series designed to cover the ethnology of South Africa, the author discusses the social, economic and religious life of the Hottentots and Bushmen. Dr. Schapera has aimed at providing, in one volume, a comprehensive review of Khoisan culture, and his own observations are supplemented by a critical summary of former investigations.

The social, economic and religious customs of the Khoisan peoples have already been described by many students of African culture, and are, no doubt, comparatively well known. But Dr. Schapera throws interesting light on the decorative and pictorial art of the Hottentot and Bushman, the significance of their dances and their conception of music, about which little has hitherto been known. The pictorial art of the bushmen consists of paintings and engravings executed on rock surfaces, and is, perhaps, the most remarkable feature of their culture. The practice of this art seems to have died out almost completely, a necessary consequence, no doubt, of the virtual extermination of the artists themselves. The paintings and engravings remain, however, as a valuable record, and have proved an important link in the chain of evidence connecting the bushmen with the prehistoric cultures, not only of South Africa but also of East and North Africa as well as of South-Western Europe.

The technical processes employed in the execution of the designs appear to have been fairly simple. The rock surface in its natural state was employed as canvas; broad plane surfaces were preferred, but where these were not at hand, no trouble seems to have been taken either to polish the rough surface of the rock or to level it in any way. The only implements used in making the engraving were small pieces of hard stone with a serviceable point. With these, the artist would laboriously chip away at the rock surface until his design was complete. Some of the engravings consist of only an outline drawing, produced by more or less rough pointing and punching, giving the design an appearance known as "pocked." Sometimes the outline is completely filled, so that the engraving consists in a design uniformly pocked over the surface. Some of the engravings done in this way are extremely beautiful.

Recent investigations have shown that the paintings and engravings are not all of the same age, but that a chronological sequence can be seen in style and technique. Moreover, different styles occur in different geographical areas. The objects depicted are for the most part animals and human beings, although inanimate objects also figure occasionally, such as weapons, clothes, or trees.

Public interest in Africa is steadily growing; administrators, economists, educationists and missionaries are each in their own way striving to mould the life of the native on European lines. Those who doubt, or at least find difficulty in understanding, the culture of the African—and they appear to be numerous—should certainly read Dr. Schapera's book. Much of it is not new, but the results of former investigations are, for the most part, not readily accessible, and such a survey as this is welcome.

Your Character from your Handwriting. By C. H. BROOKS. (Allen & Unwin. 3*s.* 6*d.*).

Although the practice of reading character from handwriting is by no means new, it is only recently that this interesting study has come to be recognized as a coherent science. Even now it appears largely to be in an experimental stage. Mr. Brooks has aimed at outlining the rudiments of graphology, and sets out to show that a simplified technique for the analysis of handwritings can be learned by any person of normal intelligence who is sufficiently interested in the subject to read his book. There are certain branches of science, particularly those in the experimental stage, which it is impossible to treat adequately in a small guide book. Mr. Brooks' book is inadequate, not through any failing on the part of the author, but because his subject is altogether too vast and intricate to be disposed of in a hundred pages. There is a foreword by Dr. Robert Saudek, who recently contributed to *Discovery* on the subject.

So many factors must be taken into consideration before attempting an analysis of handwriting that the subject is by no means as simple as it may seem. Forms of handwriting are not determined exclusively by the character of the writer. Character is only one of a number of influences. Manual dexterity, a good memory for forms, ill health, bad materials, or the method of writing learned in childhood all help to form a hand. The author sets out to show how these traits may be distinguished, but it seems doubtful whether it would be advisable for a beginner to attempt an analysis after such brief instruction.

An illustration shows two sentences written by a man in his normal hand. A second illustration shows the same text written in an enlarged, embellished and more elaborate style. The artificial writing appears to be the work of an entirely different person. It is considerably larger and exhibits eccentric curves and ornamentations for the simple forms that distinguish the natural hand. The author points out that, on closer examination, the disguised writing is found to be inconsistent, and that the writer frequently fails to sustain the assumed role. It is to be concluded that the writer of this passage was normally of a simple, unassuming disposition and the ornamentations in his second passage were not a true indication of his character. Mr. Brooks gives another example to show how a man who normally wrote with a flourishing hand was asked to write as simply as possible. The results of this experiment show that the writer was normally an ostentatious man, and that the simple writing of his second specimen was artificial. This, of course, is quite straightforward, but how is one to decide, in attempting analysis of a flourishing hand, whether the writer merely added the ornamentations out of sheer exuberance of spirits and was normally a quiet, retiring man, or whether he was by nature ostentatious and the inconsistencies were due to an attempt to appear retiring?

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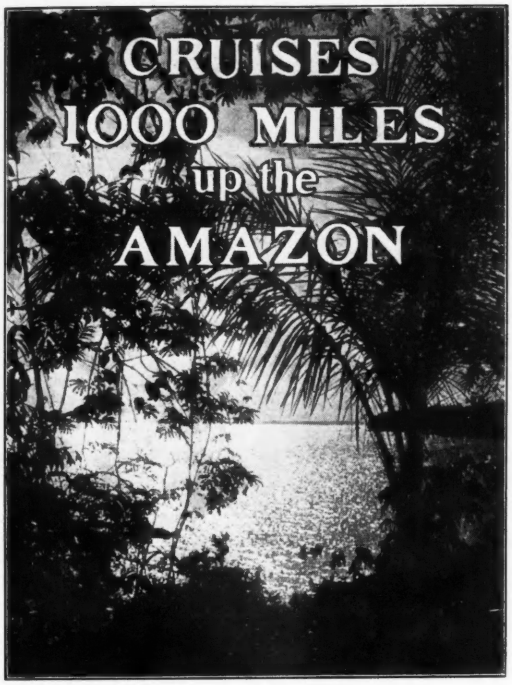

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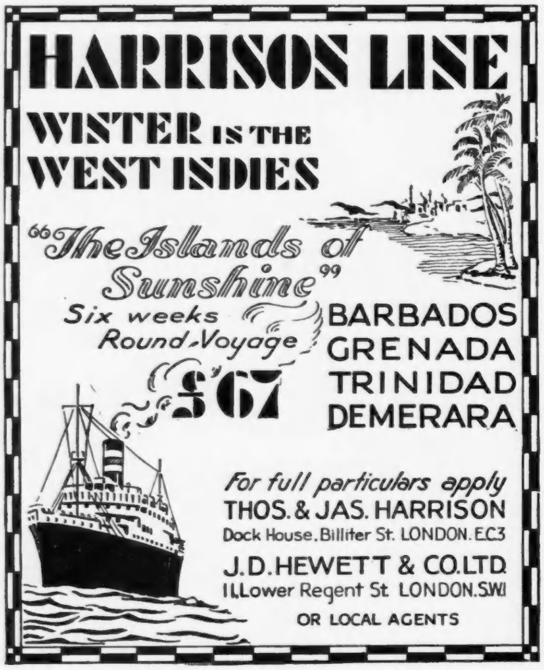

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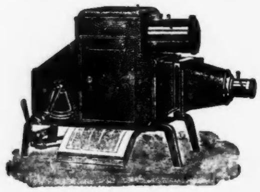

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